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AEROSPACE

DASA's Schrempp on Super Jumbo Aircraft Negotiations

93P60141 Hamburg *DER SPIEGEL* in German 25 Jan 93 pp 88-89

[Interview with DASA head Juergen Schrempp; no interviewer, place or date given]

[Text]

[**DER SPIEGEL**] Deutsche Aerospace (DASA) intends to work with the U.S. firm Boeing to prepare the development of a super jumbo aircraft. Is there really a need for an airplane with up to 800 seats?

[Schrempp] That is just what we want to investigate thoroughly, not alone but rather together with our European partners in the Airbus consortium and with the Boeing company. So far there are estimates that 300 to 500 airplanes of this size could be sold.

[**DER SPIEGEL**] The trend is towards smaller airplanes. There are hardly any jumbos used on the North Atlantic routes, for example. Instead, airlines offer more and more nonstop connections with smaller planes.

[Schrempp] The market is certainly not large, but it remains to be determined how large it is. In general we assume that airplane traffic will further increase. It is a realistic assumption that especially in the Pacific area or also in Latin America there is a need for airplanes with 600 to 800 seats.

[**DER SPIEGEL**] But where are the super jumbos supposed to take off and land? The airports are not now able to handle planes of this size.

[Schrempp] In our joint study we intend to investigate what facilities are necessary for such big airplanes to be loaded and unloaded. Certainly, larger terminals and another kind of passenger gangway are necessary. But that in itself does not rule the plane out.

[**DER SPIEGEL**] Won't there be difficulties when up to 800 persons are sitting in a plane for many hours? Passengers will want to eat or need to go to the bathroom.

[Schrempp] That is true. For example, it will be difficult to carry enough water on board. Such questions are also topics for the study. Another important part involves all the ecological questions connected with such an airplane.

[**DER SPIEGEL**] Why do the Europeans insist on working together with Boeing? After all, the Airbus consortium can build a large airplane by itself.

[Schrempp] So far we have been assuming that the market is too small for two competing aircraft. The development costs alone cannot be borne by one manufacturer. Therefore I have long advocated such cooperation.

[**DER SPIEGEL**] The Airbus managers in Toulouse do not think much of the plans of their partner companies.

They fear that a new airplane could also compete against their own A340 long range plane.

[Schrempp] Let's wait to see what the study produces. After all, the new airplane wouldn't be delivered until after the year 2000. Then the A340 will have been on the market for a long time, and moreover it covers a completely different segment of the market.

[**DER SPIEGEL**] Perhaps the Americans are cooperating with the Europeans only so that the latter don't produce a plane to compete with this jumbo?

[Schrempp] I have no doubt that Boeing is seriously interested in cooperating with us in this matter. But even if this is not so: the joint study does not necessarily mean that the Europeans will also build such an airplane together with Boeing. All options are left open.

[**DER SPIEGEL**] Are the four national Airbus partners—the Germans, French, British and Spanish—willing to include other aircraft manufacturers in the transatlantic alliance?

[Schrempp] It is conceivable that the Italians, among others, will be involved. It is likewise desirable that Russian aircraft manufacturers will participate. It is said that Boeing would also like to involve the Japanese and the U.S. firm McDonnell Douglas.

[**DER SPIEGEL**] Does Deutsche Aerospace claim a leading role among the Europeans?

[Schrempp] We did indeed provide the initiative for the project, but we are not seeking to be system managers. In view of the enormous financial risks, among other things, DASA would be content with a share of about 25 percent. In any case, the Europeans would have to share system management with the Americans in the case of a joint airplane.

[**DER SPIEGEL**] Will the antitrust authorities even allow the aircraft manufacturers to form a worldwide cartel?

[Schrempp] If the market is really so small that there can only be one airplane, then I anticipate no problems.

WEU Center To Use SPOT Images

93WS0214A Paris *AFP SCIENCES* in French 23 Dec 92 pp 6, 7

[Text] Paris—The overlap between military and non-military space systems in Europe was recently reconfirmed 21 December when the Western European Union signed a three-year agreement with Spot-Image Company. The company will supply WEU's data-interpretation center near Madrid with pictures from France's SPOT earth-observation satellites.

The 25-million French franc [Fr] accord was signed by Barry P. Blaydes on behalf of the Western European Union center, and by Gerard Brachet, Spot-Image's CEO. According to the communique published by the company, the agreement calls for Spot-Image to supply images between 1993 and the end of 1995. That period

corresponds to the experimental phase of the center, which is housed at the Torrejon airbase.

The decision to create the center was made in November 1991. During the two-year experimental period, it will use SPOT pictures to develop interpretation methods and training for image-analysis specialists, who will verify treaties, manage crises, and monitor the environment. When the center is operational, it will be staffed by 50 specialists drawn from every country in the organization.

Spot-Image, a subsidiary of the National Center for Space Studies (CNES), manages two satellites, Spot-1 and Spot-2, which were launched by Ariane on 22 February 1986 and 22 January 1990 respectively. The company receives the pictures from its satellites and commercially distributes them, together with related services, throughout the world for use in geological research, land occupation studies, and cartography. SPOT images were used extensively during the Gulf War, both for their quality and for the surface area each one covered. The images provided a broader view that complemented the picture supplied by American spy satellites in various combat zones.

The 59th Ariane is scheduled to launch Spot-3 in September 1993. The fourth SPOT, which should be placed into orbit in mid-1994, is under construction at a cost of Fr1.3 billion. It is expected to keep the Spot system going until the turn of the century. Spot-5's mission and hardware are now under study by the CNES and the French general staff.

The Helios-1 and -2 military observation satellites will be in orbit at the same time as these civil satellites. Their construction is based on Spot-4's platform and they are currently being developed through joint financing by France, Italy, and Spain. Helios-1 is expected to be ready for launch in late 1993.

France, Germany To Build Rocket-Engine Center

93WS0214B Paris AFP SCIENCES in French 23 Dec 92 p 7

[Text] Paris—To prepare the rocket engines of the future, France and Germany have recently decided to build a European research and technology test bench that will cost 61 million French francs [Fr]. It will be installed at the German Center for Aeronautic and Space Research (DLR) at Lampoldshausen, near Stuttgart, and is expected to be operational in 1995.

An agreement protocol was signed 18 December in Stuttgart between Daniel Mugnier, CNES director of launchers, Professor Walter Kroll, DLR president, Jean Sollier, CEO of the European Propellant Company (SEP), and Helmuth Dederra, the director of marketing and space programs at DASA (Deutsche Aerospace).

The bench, which the CNES communique calls "a symbol of the collaboration between France and Germany's government organizations and private industries," will be used for gaseous hydrogen and liquid

oxygen combustion tests up to a pressure of 300 bars. It will be employed to develop combustion systems for cryotechnical rocket engines as well as methods for checking combustion codes, and to test new technologies such as injectors, combustion-chamber liners, and integrated flow-check systems.

The test bench, which is being funded jointly by the DLR (50 percent), the CNES (34 percent), SEP (8 percent), and DASA (8 percent), is a "good example of how Europe can rationalize its technical investments to avoid duplication and obtain more powerful equipment at lower cost," stresses the CNES.

French, Germans, Swiss Agree on EUROPESAT-1

93WS0214C Paris AFP SCIENCES in French 23 Dec 92 p 10

[Text] Paris—On 18 December, France Telecom, Deutsche Bundespost Telekom, and the Swiss PTTs confirmed to the European Satellite Telecommunications Organization (EUTELSAT) that they would like to see EUROPESAT-1 launched in late 1994. The decision to build and launch the big live-television broadcast satellite was made at the last Franco-German summit in Bonn on 4 December.

Matra Marconi Space will be the chief contractor for EUROPESAT-1, which will weigh 2,110 kg at launch and will be based on the Eurostar 2000 platform. British Aerospace and the German firm ANT will also be involved.

EUROPESAT-1 is the first in a potential string of three satellites, and will serve the needs of the first three of the nine countries that are interested in the EUROPESAT system. Those three made the decision to launch the program in December 1990. The nine include Germany, Austria, France, Italy, the Netherlands, Portugal, Sweden, Switzerland, and Yugoslavia. For France and Germany, EUROPESAT-1 is expected to replace the TDF-1, TDF-2, and TVSAT-2 satellites.

Substantially more powerful than France's other telecommunications satellites, Telecom-1 and Telecom-2, or than Luxembourg's Astra, EUROPESAT-1 will cover France, Germany, and Eastern Europe. Most important, it will be able to broadcast high-definition television images. Originally, France Telecom had reserved five channels on EUROPESAT-1, Deutsche Bundespost Telekom eight, and Switzerland the 14th available one.

According to EUTELSAT, which will manage the satellite on behalf of its 33 member countries, the construction, launch, and operational startup of the satellite is expected to cost ECU200 million. The system's other two satellites may be launched in 1996.

Airbus A-340 Certified in Europe

93WS0214D Paris AFP SCIENCES in French 23 Dec 92 pp 12, 13

[Text] Toulouse—Representatives of 18 European countries belonging to the JAA awarded Airbus Industries'

latest creation, the very-long-haul A-340, certification on 22 December. The airliner has an operating range of 14,300 km and can carry 263 passengers.

The mood at the ceremony was optimistic despite Northwest Airlines' recent cancellation of an order for 50 A-320s and 24 A-340s. Many aeronautics professionals attended, among them Karl Koplin, JAA president, Pierre-Henri Gourgeon, director of France's Civil Aviation, and Heribert Flossdorf and Jean Pierson, general director and administrator of Airbus Industrie.

Joint certification of the A-340 enables the aircraft to begin service in European airlines, and signals the end of the A-340 assessment program that was launched in 1988 and of a round of flight tests of the ultra-modern craft. During the airliner's flight testing, deemed "the most thorough in the history of aviation," six A-340s racked up over 2,400 hours of flight in 750 missions.

"The flight tests," affirms the consortium, "proved that the A-340 was perfectly able to withstand extreme operating conditions, whether they involved hot weather and high altitudes, flight in polar regions, repeated lightning bolts, or very powerful electromagnetic interference." According to the European consortium, American certification authorities (FAA), which participated in several flights, are expected to approve the plane before the end of February.

There are two versions of the quadrijet A-340, the A-340-200 and the A-340-300. The first has an operating range of 14,300 km with 263 passengers aboard; the second can travel 13,300 km carrying 295 passengers. The A-340 and its counterpart—the twinjet medium-haul A-330, which is being tested—have together accumulated 460 promises to buy, including 256 firm orders.

France: Concorde Successor Technology Discussed

Concorde Successor

93WS0217D Paris *L'USINE NOUVELLE TECHNOLOGIES* in French 10 Dec 92 pp 46-47

[Article by Michel Vilnat: "The Technological Bets of the Future Supersonic Engine"—first paragraph is *L'USINE NOUVELLE TECHNOLOGIES* introduction]

[Text] How to develop an engine while reconciling economy at supersonic speeds with a quiet takeoff, and low speeds with high speeds? Alain Habrard, the SNECMA [National Company for Aircraft Engine Study and Manufacturing] research director, presents the solutions contemplated for the MCV-99 engine.

By the year 2010 or so, Concorde will take a well-deserved retirement. Meanwhile, the world's largest aircraft manufacturers are already working on its successor. Experts, besides, have rather precise ideas concerning the characteristics of this future supersonic aircraft, which will have a speed of Mach 2.2-2.4 and a range close to 10,000 km. As for its passengers, current studies expect it will carry 200 to 300.

The most difficult problem to be solved has to do with the engine. Ecology commands that it should not pollute much: it will fly at high altitude, close to the famous ozone layer! In addition, this "Super-Concorde" will have to comply with present noise standards. However, current studies show that the famous "bang" that occurs when the sound barrier is crossed will not be eliminated soon. As a result, the transition to supersonic speed will have to take place above the ocean or above populated areas. This constraint will force engine manufacturers to design jet engines capable of operating at both Mach 0.9 and Mach 2.2.

Developing and making such engines is so expensive that large aircraft manufacturers have decided to work as partners. This was already the case for SNECMA and Rolls Royce, who were recently joined by Fiat Avio and the German engine manufacturer MTU [Motoren und Turbinen Union]. Volvo also takes part in specific studies, such as the one on combustion chambers. However, even before this alliance [sic] (Aerospatiale's code name for the future supersonic aircraft), preliminary projects had been developed. Named MCV-99 by SNECMA engineers, the engine is now the subject of detailed studies.

To meet the work specification requirements, the MCV-99 will rely on a number of technical innovations, as explained by Alain Habrard, director of research and advanced studies at the SNECMA technical directorate, and assistant general manager of the Hyperspace project economic interest group formed by SEP [European Propulsion Company] and SNECMA to develop hypersonic propulsion (above Mach 5). But this is a much longer-range project (about 2030), as it will require gigantic technological leaps.

MCV-99 Engine

93WS0217D Paris *L'USINE NOUVELLE TECHNOLOGIES* in French 10 Dec 92 pp 48-50

[Interview with Alain Habrard, SNECMA research director, by Michel Vilnat; place and date not given: "Alain Habrard: 'Two Engines in One'"]

[Text]

[Vilnat] Although it is destined to propel the future aircraft at speeds close to that of the Concorde, will the MCV-99 engine be very different from the Olympus engine?

[Habrard] The MCV acronym stands for variable-cycle engine. In other words, this jet engine will have to operate differently depending on the desired speed. We thought of having recourse to this technology to reconcile imperatives that, at first sight, seemed to conflict. This turbojet engine must not make more noise during takeoff than a traditional jet, but it must also be fuel efficient at supersonic speeds. Now, the number of decibels increases with the gas ejection velocity. At takeoff, it must not exceed 450 meters per second [m/s]; on the other hand, to achieve good efficiency at Mach 2.0, the gas velocity will have to be as high as 900 m/s.

The variable-cycle engine will therefore behave like a traditional engine at low speed, and like a supersonic jet engine at high speed.

[Vilnat] What does the architecture of such a jet engine look like?

[Habrand] Actually, what you have is two engines in one. Considering that thrust is the product of an airflow by the ejection velocity, a strong airflow will be needed at takeoff to make up for the low ejection velocity. The latter is also beneficial during subsonic cruising, as it will reduce fuel consumption. These facts plead in favor of a large-diameter engine, like the CFM-56 designed for the Airbus A320/A340. On the other hand, supersonic cruising will require a high ejection velocity and a small-diameter engine in order to reduce drag. The challenge, therefore, is to force a large airflow through a "small" engine.

[Vilnat] How did you manage to solve this thorny problem?

[Habrand] The idea is to use an airflow multiplier at low speeds. The solution, developed by SNECMA, consists in taking advantage of the gasflow restriction that occurs during compression. The space available in this "wasp waist" is then used to house a fan, which fits in the shadow of the main compressor front. This fan, which is provided with additional air intakes, is driven by an independent turbine. That way, the flow multiplier swallows additional air during takeoff and during subsonic stages. Then, as the speed increases, the air intakes are closed and the second fan stops turning. This arrangement also removes the need for postcombustion systems (like those of the Olympus engine), which are considered to be too noisy and to use too much fuel.

[Vilnat] What new technologies will you use for the MCV-99?

[Habrand] The most important one deals with the development of new combustion chambers, the objective being to reduce NO_x emissions. To achieve that, we must avoid at all costs any operation under stoichiometric conditions. Such a perfect balance will generate a very high temperature that promotes NO_x production.

[Vilnat] Are there several technologies in competition?

[Habrand] Four techniques are currently being studied: premixing, staged injection, variable-rate injection, and RQL (rich combustion, freezing, and dilution). Using premixing before combustion will reduce heterogeneities and eliminate any zones with a richness close to stoichiometry. However, this technique poses combustion-chamber cooling problems. In addition, self-ignition is to be feared. With the staged-injection system, the idle and takeoff functions are uncoupled; the system includes a two-headed chamber: a large-volume idling head, and a small-volume takeoff head where a lean mixture prevails. The flow is diluted already at the air jet outlets, so as to freeze the nitrogen-oxide generating reactions (the gain is estimated to be 30 percent). But this is a complex method: the number of injectors is large; the area that

must be cooled is large; and transient speeds prove hard to control. The third method uses the principle of over-stoichiometric combustion under a small volume, followed by acceleration of the gases and strong dilution in a second lean-combustion zone. Nitrogen oxide emissions could thus be reduced to three-fourths. However, the design is difficult, and the length of the chamber is considerable. As for variable-rate injection, it makes it possible to adjust the airflow in the primary zone according to operating conditions. The gains expected, as far as NO_x emissions are concerned, are about 50 percent; the volume of the chambers is reduced and the operating flexibility increased. Studies are in progress, in particular with Volvo, MTU, Rolls Royce, etc., concerning other, still more efficient systems, but these are more difficult to develop.

[Vilnat] Will the MCV-99 engine use new materials?

[Habrand] The use of composites will become more widespread. It is estimated that 20 percent of the weight of future subsonic engines will consist of composite materials. A similar proportion might apply to supersonic engines if metallic-matrix composites, for instance titanium alloy reinforced with silicon carbide fiber, are developed. They will achieve weight gains, essentially in intermediate-temperature areas, as their application limits fall in the 500-600°C range for the time being. For instance, compressor disks could be 10-20 percent lighter. As for fan blades, they will be made of a single-crystal superalloy so as to withstand high temperatures. Such materials are also the direct result of our experience with military engines. In fact, although ceramics will withstand higher temperatures, I do not expect to see them used for fan blades, considering how hard it is to overcome defect problems. Ceramic-matrix composites cannot be considered for civil engines for the time being, because they are too susceptible to high-temperature oxidation.

[Vilnat] Apart from materials, will the MCV-99 benefit from other technological breakthroughs?

[Habrand] Of course. Electronic control will become more widespread and, in the future, equipment will increasingly rely on electricity. For instance, most ancillary systems could be provided with a small electric motor powered by an alternator placed at the center of the rotor. In addition, each piece of equipment will possess its own sensors, controlled by microprocessors; as for data transfer, it will take place through optical fibers. Of course, a lot of work will be required to ensure a very high reliability level. However, some actuators, jacks for instance, will remain hydraulic. But they, too, will become more compact and more powerful, as operating pressures will increase.

[Vilnat] You are also involved in Hyperspace projects. Are these MCV-99 spinoffs?

[Habrand] No, because the technologies involved will be radically different. When speeds higher than Mach 3 and, a fortiori, Mach 5 are considered, the cycle variation will have to be greater still, and this will require a

considerable technological leap. It will involve associating ramjet engines with rocket engines or turbojet engines, as the case may be. In addition, these ramjet engines will be able to operate at supersonic combustion velocities. Hence their name "super-ramjets." However, some research is common to both projects. It should make it possible to remove certain technological obstacles. First, the performance characteristics of materials will have to be improved: ability to withstand high temperatures, resistance to oxidation and mechanical constraints, etc. Considerable research efforts will have to be undertaken on new materials, such as ceramic-matrix or metallic-matrix composites. Simultaneously, cooling systems will have to be developed. Several possibilities are under consideration. In particular cooling of the intake air.

Some, like the British (with their Holtol project), thought of liquefying air during flight. But then icing problems occur. It is more than likely that fuels such as liquid methane or hydrogen will be used; not only do these fuels provide a lot of energy, but they can also be used to cool the engine and the airframe. To improve performance characteristics, the combustion temperatures must be increased. But current materials are nearing their limits; hence the need to improve calorie transfers.

The MCV-99, for instance, will require considerable work to design and precision-cast the fan blades in order to promote better cooling-air circulation without increasing the cooling airflow. In fact, on that engine, no liquid hydrogen will be available as a cooling source.

Portugal To Launch Communications Satellite 93WS0237A Lisbon SABADO in Portuguese 22-28 Jan 93 pp 24-25

[Article by Ana Guerrero: "Hitchhiking on Ariane 4"]

[Text] Portugal will join the "conquest of space," but without astronauts, and by hitchhiking. The "PO-SAT 1," the first Portuguese satellite, to be launched in August of this year, will open up new prospects for telecommunications....

According to its inventor, the "baby" of Portugal's space industry, a micro-satellite intended for telecommunications, is not a "spy" satellite, although it can pick up high resolution images at any point on the globe.

The "PO-SAT 1," at a cost of a million contos, is offering the National Armed Forces a virtually inviolable means of communication.

The Portuguese will enter the space race 34 years after the ex-Soviet Union's launching of the first artificial satellite, "Sputnik 1."

The "PO-SAT 1" is a micro-satellite intended primarily for voice pickup, storage, and transmission, and has a long-term objective: namely, to create a real economic and scientific basis for the development of the space industry in Portugal.

The subcontracting branch (production and export of parts and components) is one of the facets of the space industry that could be implemented in our country.

This type of industry is currently one of the largest and most lucrative businesses in the world, including cutting edge technology, and resulting in many civilian or military applications.

In addition to aiding the development of military techniques, the space industry could, in the not too distant future, be used to back the search for raw materials on other planets in the solar system, as well as helping to detect and fight pollution on earth.

It is on these grounds that Professor Carvalho Rodrigues, of the National Industrial Engineering and Technology Laboratory (LNETI), the inventor of the "PO-SAT 1," justifies the enthusiasm and immediate support evoked for his idea in the Ministry of Industry and Energy and among the private companies comprising the "PO-SAT" consortium.

Marconi, the operator of the satellite, and Efacec, Alcatel, Oema, and the LNETI, its builders, will defray 600,000 contos of the satellite's costs, and the PEDIP [Specific Program for the Development of Portuguese Industry] will participate with the remaining 400,000.

The two Portuguese teams of scientists, one operating in the LNETI and the other at Surrey University, in England, have just now initiated construction on the "PO-SAT 1."

Professor Carvalho Rodrigues comments: "Currently, 80 percent of their time is spent on devising a model of the satellite, and the remaining 20 percent, on constructing and manufacturing the mechanism to be put into orbit."

Towed by 'Ariane 4'

The Koru archipelago, in former French Guiana (the islands used as the setting for the novel "Papillon"), was the site selected for the 31 August launching of the "PO-SAT 1."

The Portuguese satellite will be put into orbit in two minutes, towed by "Ariane 4," a rocket launcher manufactured by the European Space Agency (ESA). The principal mission of "Ariane 4" is to launch a remote detection satellite of large dimensions: "SPOT 3."

This satellite will occupy the nose of the rocket launcher, that is, the so-called payload zone, in back of which the ESA installed a clamping ring that will transport six micro-satellites similar to the "PO-SAT 1."

The micro-satellites, a designation including low orbit satellites (820 meters tall), with a minimum weight of 60 kg, have been preferred to satellites of larger dimensions sometimes weighing as much as 200 kg. The latter, however, entail very high construction and manufacturing costs, hence precluding consecutive launchings.

As the aerospace engineer, Miguel Leitman, a member of the team at the LNETI handling the construction of the "PO-SAT 1," explains: "The large satellites, such as the

space shuttle, were developed based on technology of the 1960s and 1970s, and the changes that have occurred in this field since then may to some extent be compared with those in computer science. Nowadays, the latter uses a network of personal computers to carry out certain tasks that had previously been performed by more powerful computers."

Once the group of six small-sized satellites, such as the "PO-SAT 1," is in orbit, it discharges the functions of a large satellite with the very same precision; but it has lower production, launching, and maintenance costs.

Mission Objectives: Spying or Not?

With an estimated "lifetime" of seven years, the first Portuguese satellite can, in addition to performing the traditional functions of a telecommunications satellite (transmitting and storing messages), pick up high resolution images. The images will be collected and stored as cartographic data at the National Geographical Information Center, and may possibly be used for military purposes as well.

However, the inventor of the Portuguese satellite rejects the notion that the "PO-SAT 1" is a spy satellite; although he stresses that the interpretation and use of these images "will depend on who looks at them."

Officially, and for the present, the "PO-SAT 1" will create a confidential and virtually inviolable means of communication among embassies. It will also be used by the armed forces in its exercises, and in tactical communications between the continent and the archipelagos of Madeira and the Azores.

In the near future, while sitting at home, the ordinary citizen interested in telecommunications may be able to make contact with other parts of the world, provided that he has a personal computer equipped with the software and modem required for the usual telecommunications between telephone and computer networks.

The contact between the satellite and earth (for about 40-60 minutes in one day) will be controlled by an earth

station, still under construction in Sintra. From there, Marconi will undertake the maintenance, guidance, and monitoring of the Portuguese satellite.

The universities involved in the project (Beira Interior University and the Higher Technical Institute in Lisbon) will use the satellite to carry out a cosmic radiation measurement project. Cosmic rays penetrate the satellites' data "storage" facilities, upsetting their memory state and destroying the information stored there.

Finally, aboard the "PO-SAT 1" a study will also be made of the effect of space on the hearing organs of astronauts, leading to chronic deafness.

Technological Innovations

Two technological innovations will be used in the "PO-SAT 1": a satellite guidance system based on a CCD chamber, installed in the nose of the satellite, which will pick up an image with an average of five stars. When the image is transmitted to the earth station, the stars are located in a "star catalogue" (a genuine map of the sky), thus facilitating the satellite's orientation. This is intended to ensure its stability in orbit and its position which, in the case of a telecommunications satellite, is of vital importance.

The "PO-SAT 1" will also use the global positioning system (GPS) introduced by the Americans during the Gulf War. It enables satellites to determine the exact location of geographical points, requiring for this purpose only the aid of a ground data transmission source.

The uses of GPS are multiple and, in the case of the Portuguese satellite, they will be concentrated on land and sea salvage missions.

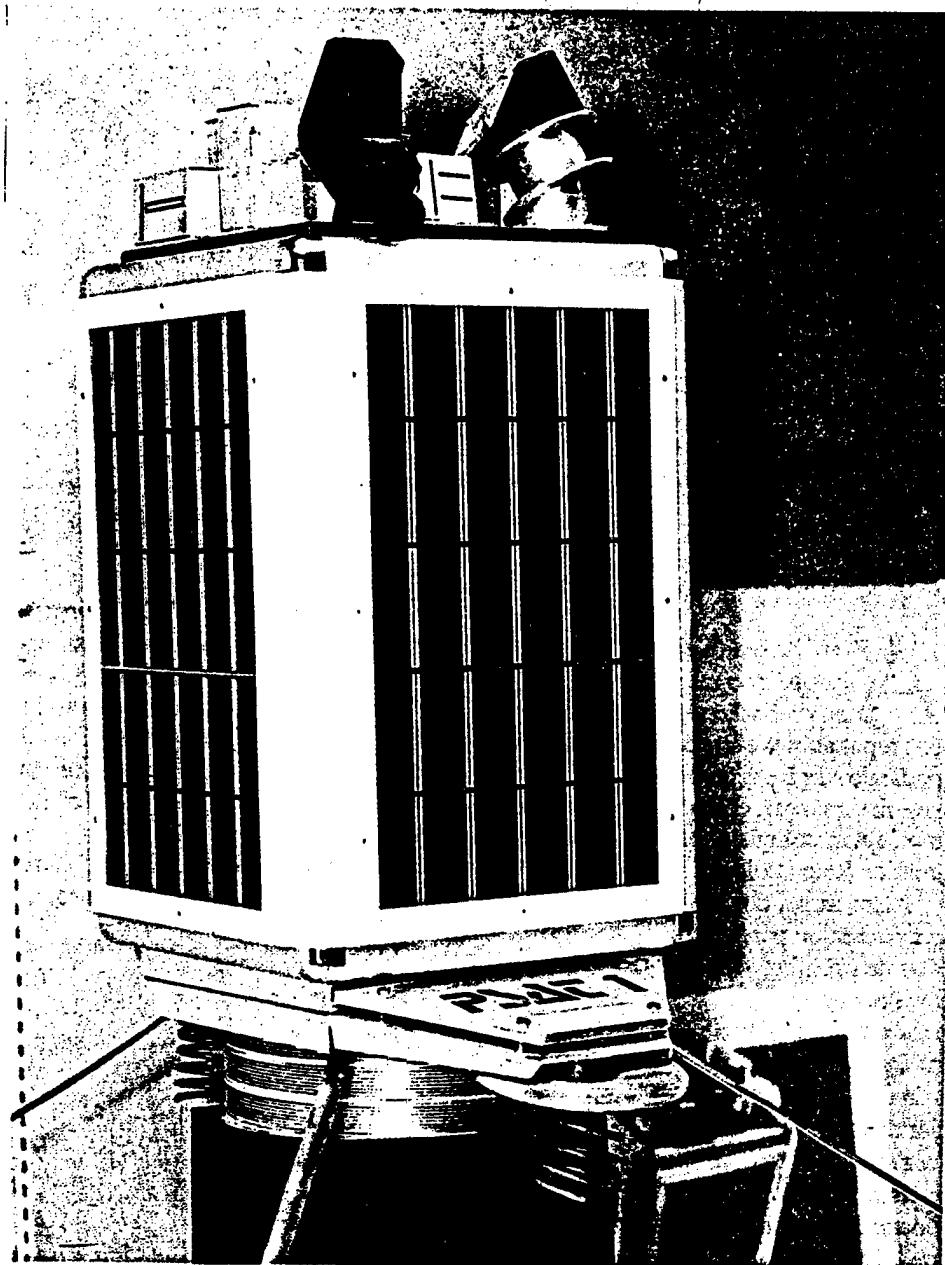
So, set your watches because, if everything goes as planned, midnight on the last day of August of this year will mark Portugal's entry into the space era. Who knows?

The 'PO-SAT' will look like this: much technology for a million contos, weighing 60 kg. [On next page]

JPRS-EST-93-008
18 February 1993

WEST EUROPE

7



Italian Space Agency Sees Need for More Basic Research Funding

*93MI0246 Rome SPAZIO INFORMAZIONI in Italian
9 Dec 92 pp 2-4*

[Text] There is no peace for "Italy in space." The situation is undeniably turbulent more or less the whole world over: financial budgets are being cut, and where they are not actually being cancelled, many prestigious programs are being reduced or postponed. A new geopolitical situation is evolving, particularly in the Old World and this will result in new alliances being drawn up when it comes to international collaboration.

As if all of this were not enough, however, the situation in Italy is characterized by an old and unresolved problem: notwithstanding the establishment of the Italian Space Agency (ASI), almost five years ago, it has yet to find the equilibrium it requires.

With, perhaps, the exception of its industrial contracts, the majority of the formal proposals put forward by the ASI's board of directors have run up against difficulties, obstacles, and criticism. These problems have, if anything, become even more acute during the past few weeks, just as the six-month period preceding the termination of all the major ASI appointments beginning with its president, Prof. Luciano Guerriero, and director general, Prof. Carlo Buongiorno, and including the entire board of directors, is about to begin. And in some areas, the countdown has already begun.

The latest skirmishes in which the ASI has been involved are, moreover, of recent date, and these have particularly concerned funding for basic research, and the difficult relationship existing between the board of directors and the scientific committee. Actually, even within the committee itself, things are not going as smoothly as they should to the extent that its president, Prof. Remo Ruffini appears to have been relieved of his office by a majority of the committee's members, who thereafter elected Prof. Sigfrido Leschiutta of the Turin Polytechnic in his place. In any event, it was precisely in regard to the disputes that exploded between Guerriero and Ruffini, that at the beginning of November, University and Research Minister Prof. Sandro Fontana, formally intervened for the first time since its appointment, with a long letter, the subject matter of which—"ASI Basic Research Irregular Practices in the Running of the Organization"—leaves no room for any doubt.

SPAZIO INFORMAZIONI is able to publish here the main contents of the letter.

The text of the letter signed by Minister Fontana reads as follows: "In relation to the events that have taken place within the space agency and particularly with regard to the criteria used in determining what quota of funding available for the National Space Plan should be allocated for basic research as well as to the relationship between the board of directors and the scientific committee, the following directive is hereby issued, to which activities of the said agency and of its organs are to conform."

The Problems of Basic Research

"According to Article 4, paragraph 4, of Act No. 186," the Minister continues, "15 percent of the national plan's effective funding is to be allocated for basic scientific research. This quota is determined against the total amount of effective funding available for the entire plan, including the amount assigned as Italy's contribution for participation in the ESA (European Space Agency). In this regard, two problems arise: one concerns the relationship between the board of directors and the scientific committee with regard to management of the available funding, and the other involves taking into consideration, when determining the reserved quota, ESA programs that focus on basic research."

As per the issue regarding the relationship between the two above-mentioned ASI bodies, Minister Fontana records in his letter that: "Act No. 186 clearly states that the formulation of proposals for the utilization of the quota is exclusively the competence of the scientific committee in that the board of directors, while being able to accept or refuse, in part or in whole, the proposals for the distribution of the reserved quota that have not been initiated by the committee." On the other hand, as far as determination of the quota reserved for basic research in ESA programs is concerned, the letter addressed to the ASI confirms that: "such a determination is to be made with reference to the effective funding available for the National Space Plan as a whole, including those amounts designated as Italy's contribution to the ESA. In addition, consideration should be given to the fact that a part of ESA activities is directed toward basic research, and in this regard, it is necessary to calculate what percentage of Italy's financial contribution is for basic research. This amount must then be deducted from the total amount of funding under the National Space Plan before the reserved quota of 15 percent is determined. Consequently, when future national plans are drawn up, the ASI will have to calculate precisely what percentage of the quota for participation in ESA programs will be for basic research."

In concluding his letter to the ASI, Minister Fontana also dealt with other equally delicate and unresolved questions concerning the agency's activities. "This Ministry," he writes, "once more calls upon the agency to give timely respect to the various other provisions of the law, insofar as the definitive placement of personnel, the failure to draw up a balance sheet within the prescribed deadline, the failure to issue an annual report by 30 April of each year, and the failure to issue a code of service, are concerned." "Continued failure to fulfill the obligations referred to above, and, more generally, failure to respect the regulations in force as well as this directive" affirms Minister Fontana on a final note "will be construed as further confirmation of the irregular practices making an intervention by this Ministry legitimate."

The ASI's Response

A few days ago, almost exactly one month from the date of Minister Fontana's letter, the ASI issued a lengthy

press release which, while formally addressing the media, indirectly supplied answers to various questions concerning funding for basic research. "The ASI board of directors which met on 1 December 1992 under the chairmanship of Prof. L. Guerriero, has been obliged to note," reads the text of the press release, "that serious and unmotivated accusations, and unfounded statements regarding the Italian Space Agency continue to be circulated, even by the press. The circulation of such slanderous statements has resulted in questions being raised in parliament and is seriously damaging the ASI's image and the interests of the country, which has employed its very best scientific and industrial resources in space activities." After having stressed that its legal advisors have been given a mandate to identify those responsible and to evaluate whatever steps are necessary to protect the agency's interests, the press release issued by the ASI board of directors furnishes further clarification on the issue of funding for basic research. The communique, in fact, reads as follows: "From 1989 to 1992 the ASI allocated a total of 177 billion lire for basic research in Italy and this should be added to the 389 billion lire assigned to basic research activities carried out by the ESA. This exceeds the minimum quota of 15 percent established by law by more than 104 billion lire, and therefore the accusation that the ASI allocated funding designated for basic research to other programs is totally unfounded. Of the 177 billion lire deliberated by the board of directors for national basic research, 9 billion lire refer to 1989, 76 billion lire to 1990, 30 billion lire to 1991, and 62 billion lire to 1992, therefore the affirmation that the 1992 budget does not make provision for basic research funding research is also entirely unfounded." The ASI press release continues: "Some time ago, the board of directors decided to allocate an extra 55 billion lire to national basic research for 1993 in addition to the 107 billion lire which represents the quota for ESA research activities and largely exceeding, also in this case, the quota of 15 percent."

SAX and Tethered Issues

The ASI press-release also provided an occasion to throw some light on the progress of two Italian space programs, the astronomy satellite SAX, and the first Tethered/TSS-1 satellite mission both of which have been the source of much controversy during the past months. "Of the 177 billion lire deliberated for basic research in Italy," the press release reads, "48 billion have been allocated for the development of scientific instruments to be mounted aboard the SAX satellite, a very prestigious program being carried out by Italy in collaboration with Holland and the United States, and which the agency inherited from the previous National Space Plan. The ASI's decision to launch the production phase of the SAX satellite and its payload of scientific instruments, was made at the request of the national and international scientific community prior to the constitution of the agency's scientific committee and with the authorization of the responsible Ministry (Editor's note: the Ministry for Universities and Research). "In this regard," the note

continues, "it should be remembered that the ASI, as a means of preventing the slowdown or even the suppression of the various programs that were already on the itinerary when the ASI was established and pending the establishment of the scientific committee referred to the previous scientific council of the CNR/PSN (National Research Council's National Space Plan), with the full consensus of all the authorities concerned. The cost of the SAX satellite, which amounts to around 400 billion lire and was rigorously fixed in the production contract drawn up in 1989, has not been the subject of any increases.

"As for the Tethered project," continues the press release, "investigations carried out by NASA clearly showed that the curtailment of the mission (the cable jammed at 260 meters preventing it from reaching the projected 20 kilometers) cannot be attributed either to the ASI or to Italian industry, since the satellite and all the other components manufactured in Italy under the direction of the ASI functioned perfectly. In addition, the Tethered mission served to demonstrate the most important aspects of the dynamics of the cable system while, because of the error mentioned above, it was only possible to carry out the electrodynamic experiments to a limited degree."

France: Ariane-5 Cryogenic Fuel Tanks Delivered

93BR0351 Paris LA LETTRE DU CNES in French
Nov 92 p 29

[Text] The first cryogenic Ariane-5 fuel tank was delivered by Cryospace to Aerospatiale on 18 September 1992 at Mureaux as part of the ESA [European Space Agency] procurement contract for the delivery of six fuel tanks. This first tank measures 23.8 meters in height, 5.4 meters in diameter, and is capable of holding more than 157 metric tons of liquid hydrogen and oxygen. It constitutes the main structure of the future European heavy launcher.

The tank, made of an aluminum alloy, is the key part of the main cryogenic stage (MCS) of the Ariane-5 rocket, which itself measures more than 30 meters in height and 5.4 meters in diameter. Although it is 15 times larger than the cryogenic stage of the Ariane-4, it has an empty weight of only 12.5 metric tons. The MCS also includes an engine mount that transmits the engine thrust to the stage. It also has a forward interstage skirt that provides the connection with the upper and transmits the thrust of the two powder acceleration stages.

The tank has two bays containing 157.2 metric tons of propellants kept at a very low temperature: fuel, liquid hydrogen (25.6 metric tons), fuel, and liquid oxygen (131.6 metric tons).

Its Vulcain engine is hinged along two axes and delivers a thrust of 85 metric tons on the ground and more than 100 metric tons in weightlessness.

The main stage works continuously for 590 seconds and provides the essential kinetic energy required to send the rocket into orbit.

After separation, at an altitude of between 100 and 400 km depending on the mission, the MCS deorbiting system takes over, and the stage falls into the sea.

The first tank delivered by Cryospace, a consortium of the companies Air Liquide (55 percent) and Aerospatiale (45 percent), will be used in the vibration tests carried out by Aerospatiale in its capacity as the main constructor of Ariane-5.

Saab Develops Engine-Running Chip

93WS0217C Paris L'USINE NOUVELLE TECHNOLOGIES in French 10 Dec 92 p 16

[Article by Michel Vilnat: "Automobile: A Chip to Run the Engine"—first paragraph is *L'USINE NOUVELLE TECHNOLOGIES* introduction]

[Text] For its new engine-running system, Saab relies on a 32-bit computer that can perform 2 million operations per second.

To meet the requirements of California's emission-control standards (the most severe in the world) that will come into force in 1999, while reducing fuel consumption by 2 percent and increasing both power output and torque, the Swedish car manufacturer Saab has just developed an engine-running system named Trionic. It includes a 32-bit microprocessor—the first one to be used on a passenger car—capable of performing 2 million operations per second. This computing power enables it to control in real time the turbocharger pressure as well as the ignition and the injection at each cylinder, separately.

Based on the pressure measured in the intake manifold, Trionic will compute the exact amount of fuel required by each cylinder. Just before injection is completed, it performs a check and makes any necessary correction if the driver has pushed the accelerator pedal. The Trionic system also controls the capacitive ignition systems that equip each spark plug, the latter delivering a series of sparks at 40,000 volts (instead of a single spark at 25,000 volts). The computer also takes into account the degree of ionization in each combustion chamber via a low-voltage signal sent to the spark plug following the spark. This technique will detect any incipient pinging and reduce fuel consumption.

Another advantage of the 32-bit technology is that it could embody the future emission-reduction systems, in particular the "Thermos" device that will eliminate cold starts.

BIOTECHNOLOGY

Netherlands: Transgenic Bull Experiments Delayed

93BR0296 Rijswijk BIONIEUWS in Dutch 11 Dec 92 p 2

[Article by Jaco Quist: "Competition for Herman"]

[Text] The advice given by the interim Ethical Control Commission of Genetic Modification in Animals,

referred to as the "Schroten Commission," to allow Gene Pharming to breed the transgenic bull Herman has been overtaken by an important development. The commission members were not aware that the production of human lactoferrin can also be achieved by modified microorganisms.

According to commission member Dr. H. Verhoogh, the experts who were consulted had not been aware of these developments either.

Alternatives

In the July (!) issue of *BIO/TECHNOLOGY*, Irish and American researchers made the claim that they had modified the mold *Aspergillus oryzae* so that it could be used to produce human lactoferrin.

In addition, the Belgian firm Biopole is working on modified yeasts in which the gene that codes for the production of human lactoferrin can be expressed. Researcher Dr. Perraudin expects lactoferrin to be on the market by the beginning of 1994. "However, the question still remains as to whether it will be cheaper than the bovine lactoferrin which we can now refine from milk." Gene Pharming would not make any statement to BIONIEUWS about these developments, but in a note to the Permanent Parliamentary Commission in Agriculture it has written that "there must be some doubt about the safety and efficiency of the drug if the lactoferrin is produced in molds. The particular process for mold-based lactoferrin production produces a structural deviation at the end of the protein chain, which may have a negative effect on the biological activities of lactoferrin and cause immune reactions in patients."

There is also the high cost of mold-produced lactoferrin: "To produce the equivalent of one transgenic cow's annual lactoferrin production, about 20 million liters of lactic mold culture would be necessary and an expensive fermentation factory would have to be built."

Postponement

In the meantime, the Parliamentary Commission has delayed a decision for two weeks until 17 December. Chairman P. Blauw said that various members saw the need for up-to-date information on the developments.

This has led to a turnaround at Gene Pharming. A few weeks ago, the Leiden company announced that collaboration with the IVO [Institute for Research into Cattle Breeding]-DLO would not be broken off in order to avoid ethical control. Furthermore, Dr. Otto Postma, director of Gene Pharming, said in a letter accompanying the note to the Parliamentary Commission that the company would be happy to contribute further input to the social and political discussions on the production of drugs by means of animal biotechnology.

Now a spokesman for Gene Pharming's recently engaged public relations bureau will say no more than that the company is disappointed about the postponement and that it doubts whether its activities in the Netherlands can be continued.

COMPUTERS

German Firms Expanding Fuzzy Logic Products

93WS0209C Paris PRODUCTIQUE/AFFAIRES
in French 20 Dec 92 p 6

[Unattributed article: "Fuzzy Logic Takes Off in Germany"]

[Text] Fuzzy logic is gaining ground in Germany. The German firm Inform Software recently began marketing an industrial fuzzy logic controller for Intel's MCS-96 product line. Following on Omron, Togai, and Hitachi, it is the first non-Japanese controller. Inform (Institute for Operations Research and Management) has been known for 15 years and was founded by Dr. Zimmermann. It distinguished itself two years ago with the introduction of its Fuzzy Tech program, which allows the user to build fuzzy logic applications without writing a single line of code. Another company, Transfer-Tech, is also breaking into this market. Established in late 1989 in the sphere of influence of the University of Brunswick, it employs a mere eight people. Still, its beacon product, the Fuzzy Control Manager program, is prominently featured in the catalog of Japan's Omron, which numbers it among its major specialties. This small German software firm is producing a great number of fuzzy logic applications for industry. Together with a small company in Hannover, it has developed an automatic setting program for machine tools for working in wood. This natural material, which varies with kind and quality, requires frequent manual resetting in order to keep the tools from splintering it. The problem was solved by recording the sound emitted by the tools. Today, operation is automatic. The machine slows down as soon as the quality of the sound ceases to match the parameters for normal tool speed. A great many machines have this same frequent resetting problem, which until now could only be solved by humans on the basis of long experience. Sheet-metal folding machines are a case in point. The setting required to achieve a given angle depends on the thickness, firing time, and cooling and is very difficult to achieve. The German firm has developed a fuzzy logic program to remedy these difficulties. Fuzzy logic applications are beginning to reach the consumer. There are already examples in the electronic and household appliance industries. The automobile industry will soon follow suit. Volkswagen is testing a car with a fuzzy-logic-controlled automatic transmission. The goal of the project is to recognize the driver's character. Pressure on the accelerator and the steering wheel is used by the computer program to modify the dynamic behavior of the transmission. The car will be adaptable. Of course, only 10 percent of German cars has an automatic transmission. However, all auto makers are expecting a boom in this market.

EC: Initial 'Open Microprocessor Initiative' Projects Reported
93BR0289 Paris ELECTRONIQUE INTERNATIONA
LE HEBDO in French 10 Dec 92 p 7

[Article signed D.G.: "Europeans Bank on Open Microprocessors"]

[Text] With a budget of ECU130 million over three years, the European OMI (Open Microprocessor Initiative) is banking on interoperability.

"The aim of OMI is to promote microprocessor-based open systems. To achieve this, standard cell libraries need to be created that can be produced by semiconductor manufacturers: This is the project's keystone, as well as its main difficulty," according to Jean-Pierre Demange of the Brussels OMI office. With an overall budget of ECU130 million evenly funded by participating companies and the EC, OMI, an integral part of the ESPRIT [European Strategic Program for R&D in Information Technologies] program, took off this year with the launch last May of most of its 21 constituent programs. These projects, which bring together about 50 companies, were selected following a call for proposals published during the summer of 1991. It should be noted that a two-year preparation period preceded the set up of the OMI program.

To achieve their goals, OMI participants are banking on using research, both in technology and software, already completed within the framework of the ESPRIT program. Participants are focusing on the development of standards for cells covering existing standards (IEEE [Institute of Electrical and Electronics Engineers]...). In practice, OMI's objectives are as follows: production of RISC [restricted instruction set computer] microprocessor cells and interfaces; designing development tools; creation of software ensuring application portability between different microprocessor architectures; development of cell standards; development of applications in the automobile, electrical household appliances, factory automation, aerospace, nuclear, and other sectors; development of test and simulation instruments; dissemination of information about the program.

RISC Microprocessors

Some 50 companies are participating in 21 projects that will last from one to four years each. Inmos, an English subsidiary of SGS-Thomson, is the main contractor for five subprojects. The first focuses on standards (Standards). The second is on interprocessor communications at the physical level (HIC) for the promotion of highly integrated interconnection systems using copper or fiber-optic media. A third, called HORN, focuses on the development of microprocessor cells destined for work stations, portable systems, and multiprocessors. The French manufacturer Chorus Systems is upgrading version 4 of the UNIX system-5 operating system within the scope of Ouverture subproject. Matra MHS, together with Sun, also part of the European OMI initiative, is developing dedicated SPARC [scalable processor architecture] versions for multimedia terminals and robot-borne industrial control systems within the framework of the SMILE [Space Mix for Liquid Experiment] sub-project. Among the other participating European main contractors are GEC Avionics (Great Britain), Siemens (Germany), Tasking (Holland), ITMI [Intelligent Machines Industry and Technology] (France), Toditec (Belgium), and the SEMA [Economics and Applied

Mathematics Company] group (France). The program also includes the American Sun and Motorola firms. There are no Japanese companies so far.

ESPRIT Program To Develop UNIX for Transputer-Based Network Environment

93BR0316 Paris ELECTRONIQUE INTERNATIONALE HEBDO in French 17 Dec 92 p 6

[Text] The European Community has just given the green light to the Harmony project, a subproject of the ESPRIT [European Strategic Program for R&D in Information Technologies] OMI (Open Microprocessor Systems Initiative) project. Harmony seeks to develop a real-time UNIX environment for networks with terminals based on Inmos transputers, both current and future versions. Ongoing research focuses on the development of a range of UNIX operating systems for hardware based on the IMS-T425 and IMS-T805 processors and of a real-time environment that is compatible with UNIX System 5 and destined for the T9000 transputers.

The participants in this project are Inmos, Archipel (vendor of computers with parallel architectures, whose Volvox computers were used as test units), Chorus Systemes SA (specialist in real-time operating systems), CERN [European Nuclear Research Center] of Geneva, and computer user Scheidt & Bachman GmbH.

DEFENSE R&D

Promethee Missile

93P60145 Paris AIR & COSMOS/AVIATION MAGAZINE in French 4-10 Jan 93 p 36

[Text] Promethee, the Apache Missile's "navigator" is one-of-a-kind sensor, capable of recognizing both the terrain over which it flies and the designated target. Thomson-CSF just delivered the first prototype.

The first prototype of Promethee, the air-to-surface stand-off Apache missile's navigation updating and target designation sensor, which is being jointly developed by Matra Defense and Aerospatiale, will undergo its first in-flight testing (on a helicopter) under operational conditions (with real-time signal processing) beginning in January. According to Thomson-CSF, this first prototype has been delivered in only two years, under a contract with Aerospatiale, in conformity to requirements and the customer's expectations. Two other Promethee prototypes, which are presently being integrated by the French electronics firm, will be delivered by the end of January 1993.

A "Smart" Navigator

Promethee's role might be compared to a navigator's task, explains Jean-Francois Agnel, updating and detection system manager for Thomson-CSF's Missile Electronics Division.

The Apache, he explains, is launched far from the target and it will follow a preprogrammed inertial trajectory, but only approximately due to external perturbations or

to natural deviations in the missile's inertial center, and above all, because of its maximum 150 km range. Promethee has thus been designed to detect in flight the missile's deviations from the course and to correct them through its navigation system by comparing the recorded images of the overflowed terrain with the experted (digitized) images that are fed into the sensor's computer from the satellite imaging maps before the mission. This "correlation" of scenes by the on-board computer makes possible the automatic updating of the missile's inertial navigation system, which at the same time, will be rectified by altimetric updating when flying above some preestablished characteristic landmarks.

In other respects, at the end of its flight, Promethee—thanks to the same image correlation process—will recognize the target (runways, infrastructure buildings, armored units, etc.). It will provide the missile with all the necessary data for dropping of the Apache's submunitions on the targets, which in the original version are anti-runway guided missiles equipped with "Kriss" submunitions produced by the Velifer consortium made up of Matra and Thomson-Brandt Armaments (TBA).

Imaging Radar

Promethee, according to Thomson-CSF, is in fact a sort of "imaging radar" equipped with a solid-state transmitter and a signal processing and image correlation system using powerful and rugged software installed in a parallel-architecture computer built on two 100,000-gate ASIC chips.

In order to create this one-of-a-kind sensor, to use Jean-Francois Agnel's expression, advanced millimeter hyperfrequency technologies were used. The choice of the very high frequency band provides the system with very high resolution, multifunction capability, and heightened resistance to electronic counter-measures (ECM). This technology is also suitable for terminally guided antitank missile systems for the MLRS (Multiple Launch Rocket System) program.

In addition, according to Jean-Francois Agnel, the Missile Electronics division in cooperation with two German firms is conducting the development of a bimodal (infrared and millimeter) guidance-sensor and is working on a millimeter (W band) electronic antenna.

WEU Builds Arms Control Satellite Center in Spain

93BR0298 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 10 Dec 92 p 1

[Article: "TNO Laboratory Collaborates in European Satellite Center"]

[Text] The Physics and Electronics Laboratory at TNO [Netherlands Organization for Applied Scientific Research] is assisting in the setting up of an arms control and crisis alert satellite center in Torrejon (near Madrid) [Spain].

In addition to TNO, the West European Union (WEU), which commissioned the new center, has chosen the

Marcol consortium, a partnership involving nine other organizations from various European countries, to build it. The WEU Satellite Center will process and analyze optical and radar pictures received via satellite in order to be able to control whether the Treaty on Conventional Armed Forces in Europe is being observed.

The TNO laboratory is closely involved with the development of a geographic information system (GIS), a data bank by means of which changes on the earth's surface can be identified.

France: 1992-1997 Military Equipment Spending Analyzed

93BR0323 Paris ELECTRONIQUE INTERNATIONAHL HEBDO in French 17 Dec 92 p 16

[Text] According to a confidential report by the Ministry of Defense that was leaked to the daily LE MONDE, France's military equipment spending should amount to 308 billion French francs [Fr] between 1992 and 1994, and Fr314 billion between 1995 and 1997. Between 1992 and 1997, the nuclear deterrence equipment budget should be down to Fr135.4 billion, representing an annual 6.6-percent drop in credits. The 1992-1997 equipment budget for space, communications, and military intelligence activities should amount to Fr85.2 billion, i.e., an average 3-percent increase per year.

Sea-air operations will receive the largest increase, with an annual 5.5-percent budget increase and an amount of Fr75.6 billion between 1992 and 1997. Funds for air and ground operations represent Fr188 billion (1.9-percent average annual growth). This distribution of the military funds apparently does not take into account the non-nuclear missile programs. Thus, the military market, which is of direct interest to the electronics industry (about 40 percent), amounts to Fr348.8 billion over the 1992-1997 period, representing a 3-percent annual average growth. Assuming that the share of electronics in the cost of military equipment increases by about 3 percent annually, it can be concluded that the French military electronics market will increase by about 6 percent annually over the 1992-1997 period. This is less than the 15-percent annual growth rate of the seventies, but still definitely better than the decrease observed last year.

French Defense Companies Explain Components Procurement Strategies

Introduction

93BR0359A Arcueil L'ARMEMENT in French Dec 92 pp 74-75

[Article by Jamel Bouzidi, head of the Electronics and Optronics Components Office of the Electronics and Information Sciences Directorate: "Components Logistics"]

[Text] This article about electronic component logistics highlights how it is seen by industry's users, mainly equipment manufacturers. It affects manufacturers, both designers and manufacturers of electronic equipment, as well as the end users of military equipment and systems;

that is to say, the general staff, which incorporates the logistics factor as early as possible in its arms programs.

Manufacturers' contributions come from department heads of Aerospatiale, Dassault Electronique, and Thomson-CSF. They represent a sample, by no means complete, but nevertheless representative of the defense electronics industry.

The increasing role of electronic components in equipment costs has led to increased importance being given to component "logistics." This is one of the main concerns of the DEI [Electronics and Information Sciences Directorate] in the area of electronic components.

The term "component logistics" disguises the fact that the problem of supplies is a critical parameter for any equipment development. It could be said that component choice methodology is hardly different from that which is necessary when dealing with systems and equipment. When making a choice, it is important to take into account all the elements that make up the components' life cycle. In particular, it is necessary to consider the criteria of durability by analyzing the constraints for maintaining the production facilities of these components operational, or the opportunities for building up strategic stocks that can be used for equipment replacements.

In this sense, it is not incorrect to talk about component logistics.

Military equipment with a 20- to 30-year lifespan seems hardly compatible with technologies having an average lifespan of five years, in the case of digital silicon technologies. Consequently, the durability of electronic components, or at least their electronic functions, must be ensured. Even today, this durability is ensured by stocks that must be kept completely optimized, or by maintaining knowledge about components no longer manufactured, which requires keeping very obsolete technologies. These solutions are clearly costly and lead to surcharges on equipment. Moreover, these extra costs are for equipment that is already in an obsolete phase when the so-called mass production begins.

These observations make it necessary to define a component selection methodology; namely, that right from a product's first design stages, the components must be the highest performers at that time. Often during a product's development stage, and to keep up with technological developments, it is necessary to go through stages of redesigning or adapting to technologies developed in the civilian sector. These stages, called "retrofits," enable the whole or part of an equipment to be upgraded. Needless to say, these retrofits lead to extra costs, which are sometimes high.

Control of an equipment's development costs, a parameter which is increasingly incorporated into the program, requires an independent equipment CAD [computer-aided design] system allowing the product to develop irrespective of manufacturing techniques. In fact, it is important to research and define new equipment design, manufacturing, and maintenance methods without

Cost of Major Defense Programs

Nuclear deterrents	New-Generation Nuclear Missile-Launching Submarine (SNLE-NG); four units to be delivered between 1995 and 2005	Fr81,500 million, including Fr33,600 million between 1992 and 1997
	M-45 strategic ballistic sea-to-land missile; 16 missiles per SNLE-NG	Fr19,600 million, including Fr12,000 million spent so far
	M-5 strategic ballistic sea-to-land missile; successor of the M-45 (three batches of 16 missiles); operational in 2005	Fr38,500 million, including Fr6,600 million between 1992 and 1997
Space, communications, intelligence	HELIOS-1 optical reconnaissance satellite; two satellites	Fr7,700 million for the French share, including Fr3,800 million spent by the end of 1991 (Italy and Spain participate in the program with respectively 14 percent and 7 percent)
	HELIOS-2 infrared observation satellite; four satellites	(Fr310 million planned in the provisional 1993 budget)
	SYRACUSE communications satellite; four satellites	Fr9,900 million
	Two ZENON electromagnetic intelligence satellites	
	Two OSIRIS radar observation satellites (with 75 percent international participation)	
	SARIGUE-NG electronic listening and spectrum analysis aircraft	Fr1,280 million (delivery in 1997)
	ATLANTIQUE-2 naval patrol plane; 28 aircraft scheduled, including delivery of 21 by late 1997	Fr24,200 million
Air and sea operations	Four HORIZON battlefield intelligence helicopters; to be operational in October 1995	Fr860 million
	BREVEL system of drones; to be operational in 1998	Fr1,400 million for the development contract
	SNA nuclear attack submarines; six units	Fr16,200 million, including Fr11,500 million spent so far
	Nuclear aircraft carrier Charles-De-Gaulle; to be operational in 1998	Fr17,200 million, including Fr4,300 million spent by the end of 1991
Air and ground operations	Order of six frigates	Fr9,600 million
	ACM (naval version of the Rafale); 86 planes ordered (deliveries as of 1996)	Amount: see Rafale
	RAFALE multipurpose combat plane; 234 planes; first deliveries in 1997	Fr170 billion, including Fr29.7 billion for development and Fr140.1 billion for production; Fr12 billion spent by late 1991
	TIGRE French-German combat helicopter; 140 helicopters in the antitank version, 75 in the support/protection version	Fr41,000 million for the French share; the program's future depends on Germany's decision; scheduled delivery in mid-1997
	NH-90; 220 units (160 for the army and 60 for the navy); initial deliveries in late 1999	Fr4,680 million development costs for France
	LECLERC tank; 650 units	Fr46 billion
	Conversion of 37 MIRAGE 2000 DA to MIRAGE 2000-5	Fr4,610 million

having to redesign it. This would allow, as much as possible, the use of the latest generations of technology in the equipment, leading to the idea of upgrading equipment technologically.

The advent of VHDL (very high-speed-integrated-circuit hardware description language) and of associated tools could possibly remove the obstacles preventing this technological upgrading. VHDL is a VHSIC (very high speed-integrated circuit) project hardware description language that processes integrated circuits at very high speeds.

The case of silicon technologies is typical of the problems encountered when designing a system. These technologies progress very fast, and the economic war waged between manufacturers leaves them weakened. This second observation is why equipment manufacturers are increasingly driven to turn to several different sources for a given type of component.

The question then arises of the sources' competence and of the technologies' quality control processes.

Finally, it becomes absolutely necessary when setting up an equipment project to incorporate in it a logistics analysis study of the components used and to estimate the costs. This is what is done with other components that are part of the costs of owning the equipment.

Aerospatiale

93BR0359B *Arcueil L'ARMEMENT* in French Dec 92
pp 75-77

[Article by Jean-Francois Petithomme, head of the Purchasing Strategy Department of Aerospatiale Missiles: "Component Logistics at Aerospatiale"]

[Text] The purchase of products and services accounts for more than 60 percent of Aerospatiale Missiles' turnover.

Aerospatiale has implemented a stringent policy for purchasing industrial products used in its manufactured goods, in collaboration with about 2,000 industrial suppliers.

Electronic components represent a large amount of business shared among some 200 suppliers, made up of approved manufacturers and distributors. Experience has shown that there is no reason to make a distinction between the logistics of electronic components and that of components in general.

Except for custom-made equipment—to which apply such criteria as functional analysis, functional specifications, logistics specifications, value analysis, and cost objectives—Aerospatiale has, for about 10 years now, employed a wagon-wheel operational method. Its aim is to reinforce standardization and optimization in component choice for definition and industrial files, while complying with the contractual requirements of government departments (GAM [War Office, Air Force and Navy], MUHAG, IT [Technical Notices]) and combined forces nomenclature lists. This plays a key part in

Aerospatiale Missiles industrial procedures; a special branch dedicated to this was created, originally planned to help the design office. It consists of component specialists who joined the Purchasing Strategy Department in 1990 to add an economic dimension to the initial technological approach to the problem. One of its tasks, therefore, is to contribute to component logistics by considering the different factors involved.

There are a number of economic and technical factors which can have considerable influence on our industrial purchasing policy:

- Programs' life cycles (in combination with contractual requirements, quality control contracts, and MCD [microprogrammed control data]), which are very long compared to the life cycle of the components purchased (rapid obsolescence);
- Time lapse between design and mass production, even its spare parts and repairs. "Designs are based on technologies that do not yet exist, and that risk, however, becoming outdated during the program's life.";
- Importance to the manufacturers;
- Discontinuity in our productions linked to customer markets;
- Management of post-production aspects, such as stocking components, having a policy for finding substitute components, etc.

This branch studies all aspects of the industrial process (design office, production department, purchase department, and client support service). It is therefore responsible for the following main tasks:

Technology watch:

- Evaluating and monitoring "manufacturing" sources;
- Evaluating and testing of new products;
- Monitoring of products' life cycles.

Reliability of supplies:

- Traceability of suppliers;
- Setting up component selection committees made up of multidisciplinary groups;
- Building of component libraries consistent with component choice assistance tools, recommendations, and preferential component lists;
- establishing of product equivalences;
- Issuing of restricted use certificates;
- Compatibility with stocks in stores;
- Drawing up of purchase specifications.

Exchanges between the different technologies involved:

- Standardization;
- Internal and external technical committees (such as trade associations, government departments).

Corporate memory:

- Information about manufacturing processes and products;
- Prices;

- Unique identification method in a purchasable products reference system.

The main task of this branch is therefore to optimize component choice in the earliest possible stage. This is achieved through in-depth examinations involving the components specialist and the designer with a view to obtaining correct performance reliability (i.e., cost, quality, etc...) in relation to functional requirements and supply durability linked to the programs' life cycle.

In this way, requirements can be met by having records of the technical and manufacturing risks incurred (risk of unavailability) with costs caused by inappropriate choices or requirements being exceeded (i.e., purchase price, implementation cost, redesign cost, component requalification cost).

By a systematic exchange of information with the client's logistics department, the Purchasing Strategy Department also takes into account integrated logistics support requirements, client feedback analyses, and summaries of component malfunctions. All these data are instrumental in controlling program life cycle costs and lead to the concepts of:

- Mid-life upgrades;
- Replacing outdated components with compatible subsystems, resulting in increased performance and optimized cost.

Dassault Electronique

93BR0359C Arcueil L'ARMEMENT in French Dec 92 pp 77-79

[Article by Bernard Geniaux, head of the Component Quality Department of Dassault Electronique: "Component Logistics at Dassault Electronique"]

[Text] There are three factors which appear to be decisive in the component procurement cycle:

- Contribution of CAPP (computer-aided production planning)
- Required standardization efforts;
- The difficult problem of durability.

CAPP Contribution

To reduce indirect costs, Dassault Electronique, for several years now, uses a CAPP system which determines, among others things, how to manage components from procurement to storage.

Each component has an identification code that contains all the information necessary for its management, such as the component's exact reference number, manufacturer, storage and procurement parameters, quality level, component evaluation data, quality control policy, etc. Also joined to the identification code are documents giving the procurement specification (if it exists) or a check list.

Required Standardization Efforts

Entering a new component into the "products data base" costs both work and money to update the "component

codes parameter list." Costs are directly related to the number of codes in the data base. To limit these, a standardization policy had to be implemented.

Dassault Electronique decided to provide its design engineers with "selection criteria" for every technology range. The criteria's aim is to help the designer come up with the right questions and lead to the selection of the "right" component. The designer remains in control of his decisions and understands the reasons for such choices. He is not presented with a fait accompli. As these selection criteria in line with internal industrial policy, their life cycle is sufficiently long not to pose any particular problem when being updated.

This new method also helps the search for secondary sources. Once the user's essential parameters are identified, the search for other sources narrows down to manufacturers satisfying these parameters.

Difficult Problem of Durability

The equipment manufacturer, having to pinpoint the risks taken with each decision, has two items high on his agenda: reducing supplier-related risks and identifying potential replacement suppliers in case the primary supplier does not meet expectations.

With regard to the former, suppliers are evaluated as to their technical, organizational, and financial reliability. The aim of these evaluations is to distinguish between preferential and risky technologies. If it is absolutely necessary to use technologies previously labeled "risky," special procurement and follow-up procedures are implemented. For preferential technologies, these procedures are reduced or even abolished.

With regard to the latter [replacement supplier], the solution that of course springs to mind is to check out several sources of supply right away. Unfortunately, this is not always possible, especially for critical components. Military equipment performance is often directly dependent on the characteristics of a few components, close to the cutting edge of technology and having only one source of supply. These components may also be highly specific manufactured to a single requirement specification.

In both cases, bankruptcy of a supplier leaves the equipment manufacturer over a barrel if emergency solutions have not been planned very early. It should be stressed that, due to the precarious economic situation of many suppliers, bankruptcies are not unlikely.

For components at the cutting edge of technology, there is no universal solution. Depending on the case, almost similar components may have been identified which would only entail relaying the boards or, if necessary, it could be considered to develop an application-specific component. When there is no realistic solution, the last resort is to stock components as a precaution.

More recently, costs have had to be cut to withstand international competition, although performance requirements are continually increasing.

To face this situation, particular consideration has been given to transposing the benefits of scale of civilian components to military equipment. The [civilian] component quality standard has unquestionably improved and many justified fears in the eighties have almost disappeared today.

However, when using these components, the durability parameter, already difficult to control with military components, is of capital importance, because the civilian market develops by renewing components every four to six years. In such a case, even multiple source solutions are no guarantee, as each manufacturer follows the others and market law takes over.

Building a strategic stock is not a satisfactory solution either, because the costs of managing, unstocking, and supervising it virtually annihilates the financial advantages obtained at the time of procurement.

Therefore, other solutions have to be considered.

The approach used for ASICs [application-specific integrated circuits] deserves to be studied in detail. In this case, it is increasingly at the functional definition level that durability is guaranteed. With this arrangement, the foundry chosen at the time of the initial design of the circuit is not necessarily the obligatory partner whose technological system alone enables ASICs to be manufactured.

The most recent CAD [computer-aided design] tools indeed allow the designer to transfer the circuit from one foundry to another and, to a certain extent, be independent with regard to silicon foundries and technologies.

Especially in the digital field, known for its gradual invasion of electronics, the "intertechnology" migration has become a reality thanks to the development and implementation of two complementary software packages:

- A cell compiler which translates the design rules of the technology in question into a set of logic blocks that make up the basic library;
- A logic synthesis tool which automatically assembles the modules using an abstract definition of the function concerned.

Thomson-CSF

93BR0359D Arcueil L'ARMEMENT in French Dec 92
pp 80-82

[Article by P. Baratault, technical director of Thomson-CSF's RCM (Radar Countermeasures) Division: "Component Logistics at Thomson-CSF"]

[Text] At least three reasons lead to granting top priority to component logistics in defense electronics:

- The increasing impact of components on equipment costs while that of labor and testing is decreasing;
- The life cycle of products is being extended, both in the development, design, and mass production stages, whereas that of some component types is shortening;

- Increasing costs of replacing components that have become obsolete during the production stages and of keeping equipment operational.

The choice of components is, therefore, of crucial importance from the very first stages of a product's design. The methodology used to make this choice is no different from that which must be applied to equipment and systems.

It is important to ensure that:

- Components chosen at the initial design stage comply very exactly, no more no less, with the requirements concerned, even if the requirements change in a later stage. The value analysis methods used at higher levels of equipment and systems are completely transposable to the component level;
- These components can be manufactured at anticipated mass production cost levels, that their quality meets expectations, and that they are manufactured using a clearly defined and stable manufacturing process;
- Durability of these components is ensured throughout the product's life, or that stocks are built that can be used as spare parts in the event supply sources dry out.

These are the basic principles of "concurrent engineering," which constitutes the main methodology development over these last years in system and equipment design. It aims to simultaneously handle the constraints of technical performances, industrial production, and logistics.

Just as in a program, risk management has now become a basic tool in project management. For components, it is important to know at any moment the risk taken and possible alternative solutions and their cost. The search for secondary sources is not new and comes well within this concept.

Increased Costs of Component Replacement

This is mainly to do with the increase in the intrinsic complexity of the components and very often their specific characteristics.

The very considerable effort put into harmonizing or standardizing design and modeling tools has ensured that this problem, with regard to digital ASICs, should be resolved in the very near future. A similar approach is called for in the analog field, but there the diversity of the industrial processes makes it more complex.

Initial Choice of Components

The quality of this initial choice has a decisive effect on the product throughout its life.

The basic tools for making this choice are the standardized references—in particular the GAMT-1 [War Office, Army, Navy, and Air Force] standard—and the companies' own criteria lists aimed at reducing the dispersion of orders, which engenders extra costs, and guaranteeing the quality of supplies.

Unfortunately, because it is necessary to plan ahead, a large number of the components to be used in complex products still do not appear on the criteria lists at the time when choices must be made. There are too many exceptions that must be made to the basic rule of choosing a component that complies with the standards. For example, on the latest generation of an airborne radar only 66 percent of the components appear on today's GAMT-1 list, and 430 exemptions, requiring special analysis, had to be granted.

This is a very serious question, which is in the process of being examined by the STEI [Technical Service for Electronics and Computers] and by manufacturers, whose obvious interest in standards of this nature can only be reaffirmed.

Mastering the Component Production Process

What matters for an "equipment manufacturer" is not of course for him to possess all the knowledge and necessary means of production. He must understand the production process in order to be able to meet requirements and ensure quality and consistency.

Mastering the production process does not end there. It is just as much a question of ensuring that the partner uses the required quality control measures as periodically checking their application.

Component Durability

This is one of the main preoccupations of equipment manufacturers. It is also one of the points that risks complicating the use of dual-use technologies (civilian and military), as the life cycles of civilian and military applications can be very different.

The necessity of maintaining reliable supply sources over a period of about 20 years is one basic reason (another being national independence from exports) for the large investments—with the DGA's [General Arms Directorate] consent—made by Thomson-CSF in silicon and gallium arsenide technologies, for example.

Component Logistics at Thomson-CSF's RCM Division

The guiding principles for organizing component logistics can be deduced in a very direct way from the observations just made.

The first main principle is to get all the obtainable advantages from possible synergies in a large group, such as better guidance when making the initial component choice, help when selecting partners, and take advantage of the benefits of scale of large orders.

This is the main role of the Joint Service for Technology and Reliability of Thomson-CSF, which is cofinanced by central funds, (to a small extent) by state contracts, and also through direct contributions from the group's divisions in their fields of interest. It carries out general analyses, evaluates technologies, and is a big support to the divisions when they make their choice.

The second major principle is to pursue strategic partnerships, primarily with the group's "Components"

units. These partnerships relations are not always trouble-free. It is sometimes difficult, for understandable reasons, for a unit that has made big investments in a particular research project to see the results of it put at the disposal of competitors.

But, if these problems do exist, they should not hide realities. The RCM Division, for example, will equip all its scramblers (amounting to several hundreds) exclusively with French tubes, its countermeasure equipment with French GaAs, etc....

The third main principle is to have the following three key component logistics units in the division, working permanently in close association with the designers as integrated teams, project by project:

- Marketing-purchasing unit, attached to the procurement department;
- Component qualification unit, responsible for issuing use approval certificates attached to quality control processes;
- Manufacture control unit, attached to industry.

Success lies in the ability of these three different units to work together with the designers from the very start of a project.

France: 1993 Defense Budget, Programs Reported 93BR0361 Arcueil L'ARMEMENT in French Dec 92 pp 132-141

[Article by Pierre Lamoulen, chief armaments engineer in the Plans-Programs-Budget Department: "Defense Budget for 1993 and the 1992-1994 Program Law—A Controlled Deceleration of Defense Expenditure"]

[Extract] In submitting the 1993 defense budget to the National Defense Committee, Pierre Joxe [minister of defense] stated:

"We are carrying out a controlled deceleration of our defense expenditures without sudden changes or drastic reductions."

"Taking advantage of the historical circumstances created by the disappearance of the threat from Eastern Europe, we are seeking to make savings. We are reorganizing our forces, streamlining them so as to have a stronger, more concentrated army at our disposal."

"(...) While a difficult change is taking root in our defense apparatus, the 1992-1994 program—in contrast to so many other laws which have ended up in the graveyard of vain resolutions—is being implemented via the 1992-1993 finance laws. I hardly see how it can be any different in 1994."

The 1993 defense budget has been established in CPs [payment credits] at 197,910 million French francs [Fr] (excluding pensions and social benefits). Compared to 1992, its growth rate is 1.35 percent in value. Assuming GDP price hikes of 2.9 percent, this budget means a cut of 1.5 percent in volume. Pensions represent Fr47,726 million, an increase of 5.75 percent compared to 1992.

Defense's budget share in the GDP should drop to 3.14 percent. This share has been falling continuously since 1987.

In the national budget, the portion for defense should be 14.48 percent—also a drop.

The budget reflects two main trends:

- An increase in expenses for RCS (wages and social security) and in operating costs (Title III), mainly due to the strong rise in wage payments. These, in fact, amount to Fr94,976 million. Compared to 1992, they are growing at a rate of 2.86 percent;
- Maintenance of equipment credits at the 1992 level at current value. Title V has been set at Fr102,934 million (or a drop in 2.9 percent by volume).

The growth in the percentage represented by Title III in the defense budget, begun in 1990, is continuing.

Title III grew by 2.86 percent, reflecting the efforts made in favor of staff by means of salary increases, the implementation of wage agreements concluded in the public sector, and the Durafour Protocol, which upgrades the role of the military.

This has been accompanied by a tightening of staff. Thus, a loss of 22,400 jobs is forecast for 1993, including 16,500 conscripts, 1,500 active military jobs, and 4,400 civilian jobs (including 1,805 in the ranks of the DGA [General Delegation for Armaments]). Nevertheless, jobs are being created in the Gendarmerie (1,000), the army (650 lance-sergeants), the DGSE [Directorate General for International Security] (78), and the Ecole Polytechnique (60 students).

The overall result of these developments is that the apparent 4.82-percent increase in wages and social security payments compared to the past year will represent an increase of 5.52 percent in constant jobs.

Title III takes account of the creation of the Directorate of Military Intelligence (DRM) and the Directorate of Strategic Affairs (DAS). It includes Fr200 million for measures to accompany the restructuring.

In Title III, the former joint DGA [Armed Forces Equipment Authority] section represents approximately Fr3,800 million. Credits earmarked for operations and activities remained stable (Fr1,190 million in 1993), but the situation shows some contrasts (priority given to the Ecole Polytechnique—increase in the number of students—and a decrease in operating credits for the majority of DGA departments).

Structure of Title III by Command: 1993 Payments Credits

Air Force	16%
Ground forces	18%
Navy	15%
Police	18%
Joint section	22%
Title III = Fr94,975 million, i.e., up 2.9 percent compared to 1992	

Breakdown of Title III: 1993 Budget

Wages—social security	74%
Food	14%
Petroleum products	3%
Equipment maintenance program	4%
Railroads	2%
Operations	3%

Title V [equipment credits], in payment credits expressed in current francs, is exactly equal to that passed in 1992, namely a drop in volume by 2.9 percent. To the Fr102,934-million budget, Fr2,058 in social benefits must be added as a result of the programming law.

Program authorizations [PAs] reached Fr102,786 million, a slight drop (0.3 percent) compared to 1992.

Consequently, this investment budget is in line with the sum approved for the second annuity of the 1992-1994 military program, which provides for the renewal of budgetary credits in current francs and a stabilization in volume of resources (including social benefits) allocated to the arms programs.

The principal aspects are:

Reduced Efforts in Nuclear Deterrence

All sections included, Fr21,824 million in PAs were allocated to the nuclear sector, a drop of nearly 17 percent compared to 1992.

Payment credits were Fr26,447 million, a drop of 11.54 percent compared to 1992. Despite this cut, the modernization of the components was begun with the continuation of the SNLE-NG [New-Generation Nuclear Rocket Launching Submarine] program (official testing of the first is planned for mid-1993 and an order will be placed for the third one) and the continuation of work on the M5 missile, with a view to its becoming operational in 2005. Delivery of the last three *Mirage* 2000-N aircraft.

The CEA [Atomic Energy Commission] budget takes into account the effect on its 1993 operations of the conditional decision to suspend nuclear testing.

**Strengthening the Space and Intelligence Components:
Top Priority of the Investment Budget**

Payment credits for space activities will increase by a value of nearly 7 percent during 1993. PAs will increase sharply (+13.4 percent in value). This increase particularly benefits upstream research (almost double) and development (+27 percent), as completion of the *Syracuse II* and *Helios* programs is progressing well.

The budget includes a total allocation of Fr260 million intended to finance dual-use space research.

At the same time, in the information sector, the start-up of new programs, such as the new-generation *Sarigüe*, the *Horizon* surveillance helicopter, and information and control systems (first stage of the SCCOA, control system of the CEMA, control systems for the Army, etc.) are planned.

Increase in Credits Devoted to Defense Research

The effort begun in 1992 has continued. Resources will increase by 6.2 percent (or Fr8,137 million in CPs and Fr8,440 million in PAs). Part of the credits (Fr140 million) is intended to finance dual-use aeronautics research (in addition to the above-mentioned Fr260 million for space research).

The CRED [R&D credits] ratio will reach 6.77 percent in PAs and 6.41 percent in CPs.

Continuation of the Conventional Arms Modernization Effort

Despite a stagnating budget, credits earmarked for conventional forces will increase by a value of 4.63 percent in CPs and 5.3 percent in PAs.

The 1993 budget will permit, in particular:

—For the Navy: continuation of the *Charles de Gaulle* PAN [nuclear aircraft carrier] and strengthening of the surface fleet with the delivery of two *Floreal*-type surveillance frigates; approval of the order for three additional *La Fayette*-type frigates.

In addition, delivery of the sixth *Perle* SNA [Nuclear Attack Submarine] and delivery of six *Atlantique 2* aircraft will occur in 1993.

In addition, two *Rafale* (one ACT [Tactical Fighter Aircraft] and one ACM [Navy Fighter Aircraft]) will be ordered. The development of the NH-90 helicopter—which has just been launched—will follow at the planned pace.

—For the Air Force: delivery of 18 *Mirage 2000* (12 DA and six D) and three *Mirage 2000-N*, and continuation of the FICT program (18 converted planes, delivered in 1993). Considering the level of orders for *Mirage 2000* aircraft already reached and the decision to stagger deliveries, no new orders should take place in 1993.

However, one *Rafale* aircraft will be ordered and development of the *Mica* and *Apache* missiles will continue normally.

Finally, the minister has just decided to purchase two used A310-300s to improve long-range air transport.

—For the Army: generally speaking, equipment planning is following the army's restructuring, resulting in a certain amount of staggering and cuts. Sixty-six *Leclerc* tanks will be ordered, and 13 delivered. Necessary allocations will be included for the development of the NH-90 helicopter and continued development of the *Tigre* helicopter.

—For the State Police Force: continuation of the *Rubis* transmission program and the quarters modernization program.

Aggregate Analysis

Distribution Among Commands

The DGA faces a strong drop in CPs (-6.7 percent in value) due to cuts in nuclear programs. The rest of the former joint DGA section is growing rapidly, mainly due to the DRM's creation. A noticeable effort is being made for the State Police, and the three army branches [air, navy, ground forces] are increasing slightly in value.

Cost Categories

Development is being cut perceptibly (-2.3 percent in PAs and -4.2 percent in CPs), particularly in the DGA (-14 percent) and the navy (-17 percent).

Manufacturing operations have stabilized, with a heavy drop at the DGA (-17 percent) and a strong increase at the EMA [Military Aviation School] (+34 percent).

Munitions face a decrease (-4.4 percent in CPs and -18.2 percent in PAs).

PAs for infrastructures will increase noticeably (+9.3 percent).

Structure of Title V by Command: 1993 Payment Credits

Joint DGA	21%
Joint, non-DGA	4%
Air	25%
Ground forces	23%
Navy	25%
State police	2%
Title V = Fr102,934 million, identical to 1992 initial appropriation	

Structure of Title V Payment Credits by Cost Category

	1993	1992
Upstream research	8%	7%
Infrastructure	10%	10%
Manufacturing	46%	47%
Development	20%	21%
EPM	13%	14%
EPP	2%	2%

New Budget Presentation

The draft budget is characterized by a new presentation: on the one hand, by "modules" begun with the 1992 budget and, on the other, by a new terminology.

Structuring by Modules

The modules replace the so-called "programs group" structure. Each module is geared to one of the main defense functions in an inter-force logical system. There are six of these modules:

- Module 1: nuclear deterrence;
- Module 2: space, communications, intelligence;
- Module 3: air and sea operations;
- Module 4: air and land operations;
- Module 5: security and support (general support to all forces and to the entire state police);
- Module 6: Preparations for the future (credits allocated to research and technical investments, particularly by the DGA, and to schools).

Compared to 1992, module 1 is obviously in a strong downward trend, while modules 3 and—especially—4 are increasing noticeably.

This inter-force logical system will be enhanced in 1993 with the utilization of a new terminology, which is more compact and more flexible (seven headings instead of 18 in Title V) and, above all, which has eliminated army sections.

The great majority of articles has an equivalent in the old terminology; the designation of the article indicates who keeps the budget. Nevertheless, when preparing the budget, upstream research is grouped under articles called "reservoirs." These are divided during budget preparation, allocated by department, according to minister [Joxe's] directives, defined in a CRED meeting.

Under Title III, this new terminology has no impact on the DGA, because it is regrouped under the same heading for credits for salaries, food, and maintenance for all three army forces and the state police.

"This reform," says the minister, "will provide undeniable financial flexibility in managing operating credits. As for equipment credits, it will also facilitate the implementation and control of inter-force programs."

Structure by Modules	
1. Deterrence	23%
2. Space, intelligence, communications	12%
3. Air-sea	11%
4. Air-land	31%
5. Security, support	13%
6. Preparation of the future	10%

New Title V Terminology	
51 60	space
51 70	nuclear
51 80	other studies
52 70	technical and industrial investments
53 70	manufacturing: common services, police
53 80	manufacturing: air, land, sea
54 40	infrastructure

Before: five sections, 18 headings
After: No sections, seven headings

1992-1994 Planning

The 1993 budget is the second year of the 1992-1994 military programming, the draft law of which was filed with the bureau of the National Assembly before the summer of 1992.

This program is in line with the controlled deceleration of defense expenditure, which began in 1991.

Until that time, the French defense system was essentially organized around confrontational posturing with Eastern Europe, and reaction to possible aggression from that quarter. The geostrategic upheaval caused by the collapse of the USSR and the Warsaw Pact and the emergence of priorities better adapted to the geostrategic environment viewed at the present time, require a reexamination of this posture. This reexamination must take into account the effects of past choices regarding programs that are in their development or production stages, and all recent reforms, such as army downsizing and the reduction in the duration of military service.

In this context, the 1992-1994 program "will ensure the transition between a defense system formed to guard against an East-West confrontation, and the military machine that France will need at the end of the century."

The box below shows the planned credits and summarizes the general trends.

[Box, p 138]

1992-1994 Programming

Major Trends: CPs in millions of francs GDP 1992

Taking account of: the new geostrategic context; the downsizing of Forces; and French missions in foreign theaters.

Efforts in space, communications, and intelligence, as well as in conventional arms, to the detriment of nuclear arms.

Efforts to prepare for the future (upstream research, schools)

	1992	1993	1994
Budget credits	Fr102.9 billion	Fr100.3 billion	Fr102.0 billion
Transfer proceeds		2.0	1.0

[end box]

The 1992-1994 program is consistent with 30 years of financing laws expressing the objectives of defense policy

as regards organization and equipment. It constitutes the multiannual framework that is indispensable to the arms programs implementation.

This program was drawn up in accordance with the methodology adopted for the last two laws (covering Title V and established in constant average GDP). It is the result of 18 months of work and close contacts between the EMA, staff headquarters, and the DGA, under the leadership of the minister's cabinet.

The main programs concerned here are shown in the following table:

Projects of the Programming Law

	Revised or terminated	Consolidated or spread out	To be launched in 1992-1994	To be launched after 1994 or spread out	To be launched after 1997 or canceled
Module 1 (deterrence)	HADES	SNLE-NG; M45	M5	second component	
Module 2 (space/comm/intel)	ATL2	SYRACUSE II, HELIOS, RUBIS	ZENON; OSIRIS; SARIQUE NG; HORIZON	Patrol plane; SIC; SIR; SCCOA 2,3	
Module 3 (air-sea)	MU 90; SNA; BAMO	PANI; ACM; LAFAYETTE		FAA NG	PAN 2; ANS, trainer aircraft, emb
Module 4 (air-land)	MAGIC; S-530-D; VAB; M-2000; VAB; LOGIST. VEH.; VBL; AC3G-LP; ACCP; PR4G; MIS-TRAL	ACT; MICA; APACHE; HAP/HAC; LECLERC; SAMP	NH-90	VBM; air transport (supplies); LRM-ph3	
Module 5		Components plan; upstream research program			

"The 1992-1994 program," said Minister Joxe, "is the initial phase of the six-year cycle contained in the programming reference system, which is an internal Ministry of Defense document (approved by the ministry at the beginning of October) that serves as a guide for carrying out the arms programs. The 1993 budget is a direct result of this document."

The table shows the changes by module planned in this cycle. The significant decline in module 1 is particularly noticeable compared with, at the period's end, the initial increase with heavy growth in the M5 program.

Speaking to the IHEDN [French Institute for Defense Studies] on 3 September 1992, the prime minister said:

"Our defense system must be adapted, taking account of the changes taking place before our eyes. With prudence, because if yesterday's risks are fading away, we need perspective to be certain that those changes are irreversible. With foresight, because tomorrow's threats could surprise us, in a world where uncertainty constitutes an additional danger in itself."

"The concern to avert the threat caused by the massive imbalance in nuclear and conventional forces in Europe has disappeared as a principal imperative of our defense."

"However, confronted by a greater range of potential threats, the major objectives of our defense must be just as demanding as ever: to protect our vital interests by deterrence; to develop a capacity to take action inside and outside Europe; and to defend the entirety of our interests in the world, within the framework of our alliances."

"Adapting our resources to better attain our objectives, concentrating them around an effective system, and determining the right level of expenditure which that implies: Those are the objectives of the discussion initiated with the draft law on military programming."

Certainly, the downward revision of government armament orders in the context of this program will have major consequences for defense industries, which must make adjustments while preserving their areas of competence and while seeking new outlets. As shown in the following table from the press release on the 1993 budget, France, among all Western countries, is the one whose military budget has been least affected, and which least 'lowered its guard.'"

Several Budget Figures				
Program authorization	Changes in value		Payment credits	Changes in value
		budget	197,910	+1.35%
		Title III	94,975	+2.86%
102,786	0.0%	Title V	102,934	+0.02%
21,824	-16.7%	FNS-ANP [nuclear deterrence]	26,447	-11.54%
77,097	+4.6%	Conventional	72,625	+4.63%
3,865	+13.4%	Space	3,862	+6.60%
6,953	+2.3%	CRED upstream research	6,601	+2.3%
6.77%		CRED ratio	6.41%	
29,688	-0.2%	RDE	29,129	-2.0%
Price rise of GDP = 2.9%				

[Box, p 141]

Physical Content of Budget

In addition to the continuation without change in most programs, one can note:

In the nuclear sector:

- Order of the SNLE-NG no.3;
- Continued development of M5

In the space sector:

- Continued feasibility of Osiris and Zenon;
- Orders for Helios IIA and IIB

For the Army:

- Order of 66 and delivery of 13 Leclerc tanks;
- Order of one Horizon helicopter;
- Staggering of NH-90 development;
- Staggering of Tigre production;
- Order of six forward crossing vehicles [engins de franchissement de l'avant];
- Delivery of the last EBG (11), VAB (30), VBL (152).

For the Navy:

- Delivery of two *Floreal* surveillance frigates;
- Delivery of the SNA No. 6 (*La Perle*);
- Order of two stock ACMs;
- Order of two Panthers and delivery of the first two;
- Staggering of NH-90 development;
- More orders for ATL2 (total of 28)—delivery of six;
- Order of the first 33 VT1s (*Crotale NG*)

For the Air Force:

- Delivery of 18 Mirage 2000s;
- Delivery of last four CN-235 (transport planes);
- Delivery of first two Tucanos;
- Order of second stock ACT;
- Order of Sarigue NG (electromagnetic listening plane);
- Order of three TBM (liaison aircraft), delivery of three.

ENERGY, ENVIRONMENT

Bayer Studying Recyclable Materials

93WS0209D Paris COMPOSITES ET NOUVEAUX MATERIAUX in French 31 Dec 92 pp 5, 6

[Unattributed article: "Bayer Speeds Ahead on the Environment"]

[Text] The Bayer company is stressing its pro-environmental activities. No less than nine announcements have been made on several of the company's product lines. The studies below are only a few of those undertaken by the company to encourage the recycling of its products. Most important is its policy of integrating new grades of recycled polymer with attractive properties for the prospective customer into its commercial offering. This is materials recycling. In the case of Novodur (ABS [acrylonitrile butadine styrene]), for example, Bayer is marketing two grades. Used materials and production waste returned by its customers are recycled using the appropriate methods and then improved with additives like the other grades of Novodur. The two types of Novodur obtained meet strict quality-assurance requirements. One of them even provides better heat-deformation resistance than standard Novodur.

Vacuum Cleaner Boxes Recycled

Bayer has conducted a study with Vorwek, the vacuum cleaner maker, on the recyclability of two of Bayer products: Durethan (polyamide) and Novodur (ABS). Vorwek studied the possibility of using recycled materials in its manufacturing. Used vacuum cleaner parts, sorted by type and color, were crushed and cleaned, and the recycled material was mixed with the corresponding virgin material. A 25-percent recycled mixture was used to make new vacuum cleaner box parts with the same property levels as the virgin materials, despite a small loss in strength.

Special Technique for Recycling Compact Disks

Compact disks were also targeted for industrial recycling. Bayer, the leading maker of polycarbonate in this area, conducted a study on its special Makrolon CD product. Bayer developed a special recycling system for this polycarbonate. The compact disks are first crushed

using a special technique and then treated with an aqueous solution to separate the varnish from the layer of evaporation-deposited aluminum. The crushed material obtained after washing and drying is currently under study in a number of applications. Recycling technology is essential in this market, since all users of Makrolon CD have problems disposing of this composite material.

Ski Boots Guaranteed Returnable After Use

This is a serious venture. A pilot project has been conducted by Bayer and Nordica, the ski boot maker. Nordica has been using Desmopan, a Bayer thermoplastic polyurethane (TPU) for years because of its strength at low temperatures, stability in bad weather, and resistance to abrasion. The study was done on old TPU boot shells, which were separated from the other materials and crushed. The usual parameters for traction and abrasion resistance, hardness, elasticity, and shock resistance were measured and compared for the virgin material, the recycled material, and a mixture of both. It turns out that only shock resistance is slightly lower in the recycled material. Nordica is using a 50-50 mixture of pure and recycled materials for heel reinforcements on new boots. From the commercial standpoint, Nordica's 92-93 collection is already being marketed in Germany with a return guarantee.

Durable Bottles That Can Be Reused To Save the Environment

Glass and cardboard milk bottles may have met their master: the bottle made of Makrolon, an almost unbreakable polycarbonate plastic. According to Bayer, which is polishing its pro-environmental image, these bottles can be reused an average of over 100 times in dairies where milk is poured at 80°C temperatures. After multiple reuse, these bottles, which are already in use in Switzerland and Germany, are also 100-percent recyclable in mixtures, as demonstrated by the production of other bottles with three layers: one layer of recycled material (85 percent of the product) sandwiched between two layers of pure material.

France: New Ionometer Developed

93WS0216B Paris AFP SCIENCES in French 23 Dec 92 p 39

[Unattributed article: "Development of a New Ionometer"]

[Text] Paris—The Atmostat-Ionisation company (Atmostat-Ionisation, 21 rue Georges-Lebigot, 94800 Villejuif, tel. 46 77 67 27) recently perfected a new ionometer capable of measuring the concentration of negative and positive gaseous ions in ambient air under all conditions.

Unlike the old models, which could measure only ion flow issuing from the ionizer, this ionometer (of which there is currently only one copy) is designed to measure the efficiency of negative ion generators with precision, as well as to analyze ionic variations and their causes.

The Atmostat-Ionisation ionometer, which is portable and as easy to use as a sonometer, allows the user to make a very precise determination of the concentration

of negative ions in a room, train, aircraft, car, or workshop; near a computer or power source; in areas where people are smoking, etc. According to the maker, it constitutes "a veritable revolution" in the measurement of an as-yet poorly recognized form of pollution: ionic disequilibrium.

France: Water Treatment by Nanofiltration

93WS0216C Paris L'USINE NOUVELLE TECHNOLOGIES in French 10 Dec 92 p 13

[Article by Thierry Lucas: "Nanofiltration Replaces Chlorine"; first paragraph is L'USINE NOUVELLE TECHNOLOGIES subhead]

[Text] First tests scheduled for 1993 in Auvers-sur-Oise. Supermembranes with 10-Angstrom pores to produce almost perfectly pure drinking water.

In response to the "inventiveness" of polluters, as well as to increasingly stringent European standards, producers of drinking water are creating increasingly complex treatment devices. They intend to guarantee the quality of the water, come what may.

Nanofiltration, which will be tested at the Mery-sur-Oise plant in 1993, has the advantage of being a radical solution. Water is injected under pressure (10 bars) through an approximately 10-Angstrom-pore membrane that filters out all bacteria and organic matter. This eliminates the need to add chlorine to the network. The new technique replaces the current biological approach for improving the quality of previously sand-filtered water.

To test nanofiltration in actual practice, the Ile-de-France unified water district has chosen the Commune of Auvers-sur-Oise, located just across the Oise River. The small town (population 6,000), which offers the advantage of having an independent distribution network, will be supplied as of the beginning of next year by two nanofiltration units, each with a capacity of 75 m³ per hour.

The installation consists of cylindrical modules in which the membranes spiral around a central collector. The water passes through a series of modules and comes out perfectly pure. The membrane is made by depositing a polymer on a microporous substrate. Comparable to an inverse osmosis membrane (used for desalination), it differs in its formulation, which enables it to filter out mainly organic matter instead of mineral ions.

The year of testing in Auvers will make it possible to verify that nanofiltration actually does inhibit bacterial growth in distribution pipes, thereby making the addition of chlorine unnecessary. On the basis of the results, and taking into account the increase in the cost of water (estimated at 1 franc per cubic meter), a decision will then be made as to whether or not to expand the use of nanofiltration. The stakes are already known: the Mery plant requires a new, 200,000 m³-per-day production unit.

Antipollution Research Center Planned at Stuttgart University

93MI0293 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 23 Dec 92 p 5

[Text] The Environment Ministry in the Land of Baden-Wuerttemberg will shortly be sponsoring the Groundwater and Site Decontamination Research Center (VEGAS).

Environment Secretary Peter Reinelt has recently signed a joint contract on the subject with the University of Stuttgart and the Federal Research Ministry: "We aim to develop biological pollutant killers that render pollution innocuous directly where it occurs," he said in Stuttgart in mid-December. The facility will help optimize existing processes and develop new ones for detecting and decontaminating polluted sites and groundwater. At a cost of 8.6 million German marks [DM], half of which is being borne by the Baden-Wuerttemberg Environment Ministry and half by the Federal Ministry of Research and Technology (BMFT), a testing station with workshops and chemistry laboratories will be set up at Stuttgart University. All interested research workers from science and industry will have access to the VEGAS facilities. Building work on the university campus will commence in spring 1993, and the first practical tests are expected to take place in 1995. "To date, Germany has no other test facility of this kind, and it will provide ideal conditions for interdisciplinary research and development work," said Reinelt.

Large Amount of Polluted Land

In Baden-Wuerttemberg alone the number of polluted areas is estimated at 35,000, of which 17,000 are disused dumps and 18,000 derelict sites. Since the municipal reclamation fund was initiated in 1988, the land has spent over DM340 million on identifying and decontaminating polluted sites. Laboratory trials with site decontamination processes, for example the biological degradation of pollutants in soil, can only rarely be transferred directly to fieldwork conditions owing to the irregularity of the subsoil. Polluted sites often present a wide range of completely different soil conditions and pollutant concentrations within a short distance. "VEGAS will provide the bridge needed between laboratory trials on a test-tube scale and field trials," said the Environment Secretary.

FACTORY AUTOMATION, ROBOTICS

FRG: Machine Builders Expect Competitive Advantage From New Software
93WS0121A Duesseldorf WIRTSCHAFTSWOCHE in German 20 Nov 92 pp 94-97

[Text]

Automation

Software Above All

A German Operating System Should Intimidate Mechanical Engineers in Japan

The next generation of Mercedes is running on software. Whether it's engine management, safety features like brakes and steering, or air conditioning, an in-car computer controls everything in a universal network. The Stuttgart firm is putting its money on a German operating system, although the most important software manufacturers are in the U.S. But PXROS from Hightec EDV-Systeme GmbH in St. Ingbert has a decisive advantage: It works in real time. Instructions and control commands are carried out with no time delay.

PXROS, with the supplement OASU, belongs to a new generation of software, object-oriented programming (OOP), whose advantages (*Wirtschaftswoche* 44/1992) appeal to German engineers as well. Several companies want to use it to revolutionize metal working or automated manufacturing and to challenge the increasingly powerful Japanese competition. For Hightec managing director Rolf Strothmann, the case is clear: "Our product can do more than Japanese systems and fits into the manufacturing landscape better."

Strothmann bases his optimism on the modular construction used in all areas: from the Blaupunkt car radio with traffic report memory, which has just come on the market, to complex rolling mill trains. In upgrading production techniques, the available software only needs to be supplemented and not, as is the case today, extensively replaced. PXROS tests the newcomer's interfaces even in the programming phase. That saves time and money and guarantees the software will be able to run when the programming is finished.

An especially serious problem thus becomes less troublesome. As a study at the American space agency NASA revealed, up to 67 percent of total software costs go towards elimination of programming errors. Two-thirds of all errors are built in during the specification and design phase. Analyses following an American space shuttle flight revealed that its software still contained one error per 2000 lines of software code, even though NASA had made a tremendous debugging effort beforehand. That catapulted the software costs to an astronomical \$1000 per line. The space shuttle software contains a total of several million lines. PXROS promises similarly high quality at a fraction of the costs.

Manufacturers of mass-produced electronic articles were the first to recognize this advantage. Alcatel fax machines, Canon laser printers, Agfa-Gevaert developing machines, and Siemens telephone equipment are already controlled by the operating system from St. Ingbert. The palette of equipment and installations extends from small barcode scanners in high-bay warehouses, supplied by Erwin Sick GmbH of Waldkirch, to control systems in rail cars, like those built by AEG Westinghouse.

Mercedes has not yet established in detail which automobile functions will be controlled by software in the future. Nevertheless, the Stuttgart group has taken the first step with their S-class. A digital in-car information system, the so-called Can-Bus from Robert Bosch GmbH, controls, among other things, total engine management. BMW has also provided its largest limousines with this intelligent wiring and control. Waiting times like those in front of the monitor at the office cannot be tolerated, since most operations in the technical world demand real time: reactions without delay. That is immediately apparent with anti-lock systems (ALS); but engine control, which precisely terminates every single ignition spark for the benefit of the environment, must also register current engine data, compare scheduled and actual values, and give control commands for ignition and valves.

The finest application would be the driverless auto. What sounds utopian today has already been carried out by Mercedes-Benz in a test with a light truck. For Holger Moeller, however, utopias are a horror. The development director for the machine tool manufacturer Trumpf GmbH + Co. in Ditzingen, Swabia, is always on a very real search for solutions for his software problems. New ones arise with every improved machining center. He doesn't want to place his money on the global market leader, Japan's Fanuc, which has a market share of about 50 percent in machine tool control.

A similar view is held by Ulrich Richter, who wants to market Robert Bosch GmbH products from Erbach in the Odenwald. "Technical eyewash" is what he calls the Japanese products. Their mass-produced goods couldn't meet greater demands for user comfort and precision in machine tools.

At Emo '93, the largest trade fair in the world for metal-working machines, which takes place in September in Hanover, Richter wants to offer a top-of-the-line control system. Bosch development director Dietmar Binder chose PXROS for the operating system. And he goes one step further. Despite the fact that the whole world has decided in favor of the user interface—the operating logic—Windows from the American software giant Microsoft, Binder chose the dialog manager developed by Stuttgart's ISA GmbH. ISA was founded by members of the Fraunhofer-Institut fuer Arbeitswirtschaft und Organisation (IAO).

Thus armed, Bosch does not fear the powerful rival Fanuc as much as before, especially since the price is also right. The complete machine control system is to cost 10,000 German marks [DM], a level the Japanese have set for themselves. But the Odenwald marketers are running a considerable risk. After "tough discussions between marketing and development about the extent to which we should open our system for the customers' own initiatives," says Binder, the decision was made for an open solution. Thanks to the flexible OOP software, even rival Fanuc's user interface can be integrated if the customer so desires. Which annoys marketing man

Richter more than anything. His counter-argument: "Other interfaces, especially ours, are simply better."

Richter is aware of the risks, although a dozen German machine tools already support the new standard. For Siemens, the German market leader in the area of machine control, has not yet joined in. "We only have a chance against the Japanese if Siemens comes on board," says Richter.

The Munich machine control firm is busy with its own system, although PXROS has long been used in other areas of Siemens. Its own operating system, for example, is used in the Munich group's telephone systems. A veteran Siemens employee knows the reason for this insistence on doing it their way: "It has always been like that: Each area of business wants to rediscover the wheel for itself."

France Develops Semiautomatic Ultrasonic Test Facility

93WS0184C Paris PRODUCTIQUE/AFFAIRES in French 10 Dec 92 p 5

[Article: "Ultrasonic Nondestructive Testing: Automation of Test Facilities"]

[Text] The National Testing Laboratory [LNE] has developed an ultrasonic immersion-scanning tank for the semiautomatic testing of flat metallic, plastic, or composite-material pieces. By comparison with the conventional manual contact testing method, automation of the scanning by the transducer enables rapid and reproducible testing of pieces. This facility is equipped with an information processing system that converts images of defects and test parameters. These can be type C images (projection of defects on a plane) or type B images (in-depth projection through a cross section of the piece). The LNE also uses this facility to develop test methods more adapted to a specific type of piece or defect. The facility could also be used to characterize the beam quality of ultrasonic transducers.

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France: Chemical Quartz Cutting Process Being Tested

93WS0217B Paris L'USINE NOUVELLE TECHNOLOGIES in French 10 Dec 92 p 16

[Article by Marc Chabreuil: "Piezoelectricity; Quartz Machining: A European First"—first paragraph is L'USINE NOUVELLE TECHNOLOGIES introduction]

[Text] Quartz & Electronic Components counts on chemical machining to make the quartz wafers used in high-frequency oscillators.

A specialist of piezoelectricity, the Quartz & Electronic Components company (CQE) is currently the only one in Europe to develop quartz chemical machining. This new production technique, which lends itself well to automation, would reduce the cost of high-frequency voltage-controlled oscillators (150-200 MHz in fundamental

mode) by a factor of at least 5. These components are used in telecommunications.

The Tekelec subsidiary has fully mastered the mechanical machining of quartz wafers. But that technique is restricted to thicknesses of 32 microns, corresponding to a frequency of 50 MHz. For higher frequencies, CQE uses ionic machining, a process that is costly, slow, and complex, although it will yield thicknesses of 4 microns (400 MHz). As "average" thicknesses of 10-11 microns will be required to meet future telecommunication requirements, the company turned to chemical machining, which is said to be used by only one or two U.S. companies. This technique consists in using a very basic etchant to hollow out a "basin" at the center of the quartz wafer, the circumference of which is covered by a protective coating (the outer crown thus provides the wafer mechanical rigidity).

The studies were performed with the assistance of the National Higher School of Micromechanics laboratory in Besancon; they covered etchants, the utilization temperature (very high, it must be controlled accurately), and the etching rate (between 0.5 and 1 micron per minute). The precision achieved does not have to exceed a few tens of kilohertz, as the frequency adjustment (to 1 ppm) is done later on, during vacuum metallization.

The first results (160-MHz quartz) make it possible to contemplate industrialization at the Pont-Sainte-Marie plant, near Troyes, in 1993. The objective is to eventually automate the operation by means of a personal computer piloting a battery of chemical machining units assembled in parallel.

LASERS, SENSORS, OPTICS

German Institute Develops Variable Frequency Laser

93WS0101B Stuttgart *BILD DER WISSENSCHAFT* in German Nov 92 p 10

[Article under the rubric "Latest News": "Laser With the Right Idea"]

[Text] A new laser at the Juelich Research Center emits a 14-picosecond light pulse. Dr. Winfried Daum and Hans-Joachim Krause succeeded in designing the instrument with a lithium borate crystal so that the light's wavelength can be adjusted continuously from 400 nanometers (violet) to 1300 nanometers (middle infrared).

The Juelich physicists are using the short high-energy light pulse for studying electronic properties and vibrations of the molecules of the surfaces of metals, like silicon, for example.

The lithium borate crystal grown in China can transform light originating from a solid-state laser. It produces two beams with new wavelengths: one in the visible region of the spectrum and one in the infrared. The physicists vary

these wavelengths by changing the light's angle of incidence. "We can turn the crystal with stepping motors and cover the entire frequency range within three seconds," Daum says.

Until now such nonlinear optical effects were achieved with potassium dihydrogenorthophosphate (PDP) crystals. The new crystal transforms UV light substantially more: Its efficiency is over 25 percent, while PDP crystals reach only 5 percent.

MICROELECTRONICS

German Company Develops Fine-Pitch Laser Etching Technology

93BR0337 Paris *ELECTRONIQUE INTERNATIONAHL HEBDO* in French 17 Dec 92 p 33

[Article signed L.M.: "Laser Halves Track Interspaces"]

[Text] Laser etching produces track interspaces less than 80 microns wide and allows the installation of up to seven conductors between integrated circuit pins.

The arrival on the market of components with increasingly small connection gaps (widths between 0.5 and 0.25 millimeter—fine-pitch technology) mandates the manufacture of printed circuits with very fine conducting tracks and very fine insulation channels between tracks. The etching removal method which is traditionally used for manufacturing printed circuits does not allow track interspaces that are fewer than 80 microns wide because that is the resolution limit of most of the photosensitive resins and masks and because the etching agents do not reproduce patterns smaller than 80 microns.

Up to Seven Conductors Between Two Integrated Circuit Connections

On the occasion of the "Pronic" conference, the German LPKF company introduced a laser-based manufacturing process that can produce interspaces of 80 microns and smaller.

With this process, which ultimately will be able to achieve widths of 30 microns for the interspaces and 40 microns for the conducting tracks, up to seven conductors can be mounted between two integrated circuit connections and three conductors between two surface-mounted component (SMC) pins. It is an etching process which is applied directly (without mask) to the copper layer covering the substrate. Laser etching is generated over almost the full thickness of the copper layer. It stops five microns short of the copper-substrate interface to prevent any contact between the beam and the epoxy substrate. The insulation channel is obtained through chemical etching. In addition to the possibility of obtaining narrow insulating channels, the advantages of this process are mainly the quality of the edges, the implementation speed (copper is worked at 50 mm/second), the possibility of establishing a direct link between the designers' computer data and the actual manufacturing process, and, finally, the fact that the

equipment is able to operate continuously without tool wear. There is also a financial advantage: Production cost is not very high, on the order of 5 German marks [DM] per hour (about 17 French francs [Fr]). For the time being, this process will be used for prototype and small-batch manufacture. Mass-producing tests are, however, in progress. This technology can also be used to manufacture screen printing stencils, which must also be adapted to fine pitch.

The solution chosen by the German company involves a laser that emits at a 1.06-micron wavelength and moves along an X-Y plotting table. The copper layer covering the substrate is coated with a resin film before etching to improve laser beam efficiency by eliminating reflection phenomena. This film also absorbs any copper particles that are ejected during etching; the film is discarded at the end of the chemical etching process. However, a system will have to be provided to suck off dust, gas, and particles that are produced by the etching operation and the process itself.

NUCLEAR R&D

CERN Adopts Austerity Budget

93WS0216A Paris AFP SCIENCES in French 23 Dec 92 p 16

[Unattributed article: "CERN Budget Down, Contributions from Germany Reduced"]

[Text] Geneva—Meeting in Geneva, the council of the European Laboratory for Particle Physics (CERN [European Organization for Nuclear Research]) has adopted an austerity budget, down 15 million Swiss francs [SFr] (57 million French francs [Fr]) for 1993, and has accepted a decrease in German contributions beginning in 1994, CERN announced on 18 December.

The 18 member states adopted a budget of SFr951.67 million (Fr3.6 billion). They accepted a three-year 10-percent reduction in Germany's contribution to CERN beginning in 1994 "in consideration of the serious problems which reunification poses for this country." A reassessment will be made in 1995 in order to determine whether this reduction should be extended for two years.

Germany, which is investing a great deal of money in its own particle accelerator, DESY (Deutsches Electron Synchrotron), in Hamburg, requested a budget cut of SFr25 million (Fr95 million) and a reduction of its contribution to CERN from 25 to 20 percent (Germany, along with France, is the biggest contributor). Relief was also granted to the new, economically troubled Central European members: Hungary, Poland, and Czechoslovakia.

In addition, the council approved the appointment of the new general director, Professor Christopher Llewellyn Smith (Great Britain), current chairman of the physics department of Oxford University. Professor Smith will replace Nobel Prize recipient Carlo Rubbia (Italy) on 1 January 1994.

Mr. Rubbia stressed the soundness of the experimentation strategy adopted by CERN and emphasized the progress made in latest version of the LEP (Large Electron Collider), the LEP 200. The LEP 200 will reach the W boson pair production threshold, 160 GeV [giga-electron-volts], by the end of 1994 and 180 GeV by the spring of 1995. That will be around twice the energy level currently delivered by the LEP.

For the time being, the LHC (Large Hadron Collider) does not appear threatened. However, CERN physicists say they fear delays in its construction if other states, such as Great Britain and Spain, join Germany in calling for a permanent reduction in the budget. In their opinion, it is imperative for the LHC to be built before the SSC (Superconducting Super-Collider), on which work has begun in Texas, if Europe is not to lose its current edge over the United States in particle physics.

The austerity budget, which will have an impact on wages, has been criticized by the personnel association (3,000 members), which has expressed its "consternation." Fearing a decrease in the "enthusiasm of researchers," it has threatened a strike.

French-Dutch Superconducting Cyclotron Project Nears Completion

93MI0266 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 9 Dec 92

[Text] Next year the Netherlands will become host to a unique new accelerator for atomic nuclei. The AGOR, or Groningen Orsay Accelerator, now in the final stage of development at Orsay in France, is to be installed at Groningen University's Nuclear Physics Acceleration Institute (Dutch abbreviation: KVI).

AGOR is being constructed under a cooperative agreement between the NWO foundation FOM [Institute for Basic Research into Matter] and the French National Nuclear and Particle Physics Institute, and completion is scheduled for spring 1993, after which the first nuclear beam will be generated. The machine will be installed in Groningen in the course of 1993, where it will be used for nuclear physics and other applied research.

In a cyclotron, electric coils are used to create a strong magnetic field. This magnetic field, which must present a precisely defined form over a distance of several meters, ensures that the electrically charged atomic nuclei remain confined within the cyclotron, even during acceleration. The superconducting coils used make it possible to create substantially stronger magnetic fields than do normal coils, so the nuclei can be accelerated to far greater energies.

Unlike other superconducting machines, the AGOR can accelerate very light nuclei as well as heavy ones owing to the different shape of its coils and magnetic poles. The coils were also produced using a technology previously used only for small coils: They are coiled in one piece and impregnated with epoxy resin as a single unit. The liquid helium for cooling is located outside the coil.

This design greatly increases the mechanical rigidity of the coils, which can thus withstand the Lorentz forces created in the requisite 4.02-Tesla magnetic field.

TELECOMMUNICATIONS

Philips Subsidiary To Market Microstations

93WS0217A Paris L'USINE NOUVELLE TECHNOLOGIES in French 10 Dec 92 p 14

[Article by Thierry Lucas: "A Microstation on an ASIC [Application-Specific Integrated Circuit"—first paragraph is L'USINE NOUVELLE TECHNOLOGIES introduction]

[Text] Miniaturization and electronic-integration records with this TRT [Radiotelephone and Telephone Communications] station designed for "personal" hookups.

The world's leading manufacturer of radiotelephone equipment for sparsely populated countries, TRT, will start marketing a "personal" microstation early in 1993; it will make it possible to connect two or four users on the analog network, or two users on the ISDN [Integrated Services Digital Network].

To achieve its compactness and price objectives, the Philips subsidiary relied on maximum integration of logic functions. The result is an electronic card whose surface area was divided by three compared with the previous generation, while the number of components was reduced from 210 to fewer than 50. All logic processing on the radio frame is performed by a 30,000-gate ASIC integrating RAM [random-access] and ROM [read-only] memories. Manufactured by VLSI [Very Large Scale Integrated] Technology, the component was designed by means of Compass's computer-aided design tools.

To achieve the technological leap represented by the microstation, TRT relied in particular on Design Assistant, a pre-study tool using artificial intelligence, which makes it possible to evaluate the various ASIC-integration options. In fact, this software quickly provides the designer with an estimate of the silicon surface and power consumption corresponding to the logic functions he chooses to integrate. These results made it possible to select the solution providing the best performance/price ratio: the microprocessor was the only thing not included in the ASIC, a 40-mm² silicon chip whose price remains acceptable. Overall, the card power consumption (readouts included) and its cost were halved.

EC: Successful Test on Digital HDTV Radiowave Transmission

93BR0291 Paris ELECTRONIQUE INTERNATIONALE HEBDO in French 10 Dec 92 p 42

[Article by Loic Josselin: "Digital HDTV by Radiowave: It is Possible"]

[Text] Europe is working hard on the development of a standard for digital TV signal transmission via radio-waves. A recent experiment by the BBC [British Broadcasting Corporation] and Thomson-CSF is encouraging.

By transmitting a 60-Mbit/s digital TV signal along an 8-MHz UHF [ultra high frequency] channel, engineers from the BBC and Thomson-CSF's Rennes Electronic Laboratories (LER) claim that it is possible to "successfully" transmit at least one digital HDTV [high-definition television] service along current UHF wavelengths. To achieve this, the LER implemented the high-spectrum-efficiency OFDM [orthogonal frequency division modulation] signaling technique to its transmitter-receiver equipment. This is a weathered transmission technique that was chosen for digital audio broadcasting (DAB) and developed within the framework of the European EUREKA/147 project. OFDM is also at the basis of a RACE [Research in Advanced Telecommunications Systems for Europe] project launched very recently under the leadership of the CCETT (Joint Broadcasting and Telecommunications Study Center). The aim of the DTTB (Digital Terrestrial Television Broadcasting) project is to create a transmission standard for digital terrestrial television broadcasting. The BBC and Thomson-CSF/LER experiment was carried out in this context.

Multipath Propagation

OFDM modulation greatly improves terrestrial transmission in the UHF/VHF frequency range of signals which require multipath propagation due to the presence of buildings or natural obstacles which cause signal diffraction or reflection. The receiver indeed picks up a series of signals originated by the initial outgoing signal, but each with a certain time lag due to the different propagation paths. The resulting interference and fading causes distortion of the signal received. The larger the signal bandwidth, the greater these distortions. "In the case of a digital signal, if the symbol time is not long enough in relation to the different time lags, there will be much interference between symbols," said Alain Maloberti of the CNET [National Technology Study Center] in his article "Mobile Phone Propagation in Urban Environments," published in the French research journal L'ECHO DES RECHERCHES.

OFDM Compression + Transmission = HDTV Along UHF?

In the UHF/VHF range, these delays can reach eight microseconds. According to LER engineers, conventional QAM (Quadrature Amplitude Modulation)-type¹ modulation does not permit the development of efficient equalization techniques to correct intersymbol interference in this kind of environment².

One efficient way to counter this phenomenon is to distribute the high bit rate over several carriers and have each of these operate at a low bit rate. To achieve the highest spectral efficiency, the carriers are contiguous and have orthogonal properties that facilitate their separation at the receiver end.

In the BBC experiment, the system transmitted two different signals at a rate of 30 Mbits/s, one with horizontal polarization and the other with vertical polarization. Each signal consisted of an OFDM system with 512 carriers separated by 14 kHz, each subjected to a 64-signal-point QAM. According to BBC engineers, the experiment carried out in London was an essential first step toward a real demonstration of the transmission of two HDTV programs on a single UHF channel by associating the OFDM transmission technique with digital compression methods.

In Europe, experiments of this kind are increasing and are likely to add to the uncertainty with regard to the future analog HD(D2)MAC HDTV standard, which can only be transmitted by satellite.... Some months ago, a group of Scandinavian manufacturers presented HD-Divine, a terrestrial digital HDTV transmission system. Parallel to this, Philips's electronics laboratories, strong in DAB expertise, have also been studying the digital transmission of television images. The LEP [Electronics and Applied Physics Laboratories] has also simulated OFDM transmission of MPEG-algorithm coded images at 2.5 Mbit/s.

Footnotes

1. With QAM modulation—quadrature amplitude modulation of two carrier waves—the two waves in quadrature use the same frequency band. The symbols generated by the signal coding are represented by an x-signal-point diagram constellation (V.32 modems, for instance, use 32-point QAM modulation, whereby each symbol consists of four useful bits).
2. The symbol time is in effect 0.176 microseconds for transmitting a 64-point QAM-modulated signal at 34 Mbit/s along the 8-MHz band. This time is much too short compared to the delays caused by multipath propagation.

Dutch Government Grants 11 Million Guilders to Data Communications Projects

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[Text] Next year, the Ministry of Economic Affairs will appropriate 11 million guilders for 29 data communications projects. One of these projects is developing a key ring that will tell you when your car is due for a major overhaul. The financial incentive is necessary because there are "insufficient investments in the data

communications infrastructure in the Netherlands," says Dr. J.J. van Scheijen, the ministry's services manager.

Economic Affairs received a total of 41 proposals, 29 of which were accepted within the Pilot Data Communications Projects Program. The maximum grant is 750,000 guilders per project. The projects are subdivided into four categories. Multimedia constitutes the largest category, with 12 subsidies.

Within the framework of one of these projects, Pon—the Dutch VW/Audi importer—is developing a chip for a car's key ring, which contains information on its maintenance condition. It tells when one's car is due for its next overhaul. An ambitious project in this category, is a combined AVRO, TROS, and Veronica [Dutch television stations] project for the digital storage of television and radio archives, in order to make them remotely accessible via the ISDN [integrated services digital network].

In the area of Product Data Interchange (PDI), 11 projects received subsidies. PDI ensures the storage and exchange of production information. The government would like to promote this kind of data exchange, particularly in industry and construction. It is not only for these sectors that project proposals were accepted. Road construction, hog farming, and welfare payment organizations are also involved in PDI.

One of the three projects accepted in the area of computer security was submitted jointly by Beanet, Bankgirocentrale, and Rabobank. In the next five years, electronic payment systems should become generally available. However, smart-card shopping is still rather tricky. Transactions must be processed very accurately so as not to exasperate the customer or storekeeper. For this purpose, a special backup facility is in the making.

Health Care

Three grants were approved for a project in the field of smart cards and electronic labels. It deals with the development of smart cards for patient registration, in particular for the health insurance company DWS. Besides personal details, financial and laboratory information will also be stored on the card. This will facilitate communications between the doctor, patient, and insurer.

Through this subsidy policy, the Ministry of Economic Affairs seeks to promote the development of a high-quality data communications infrastructure in the Netherlands. According to the Ministry, this is an indispensable condition for the implementation of many applications.

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